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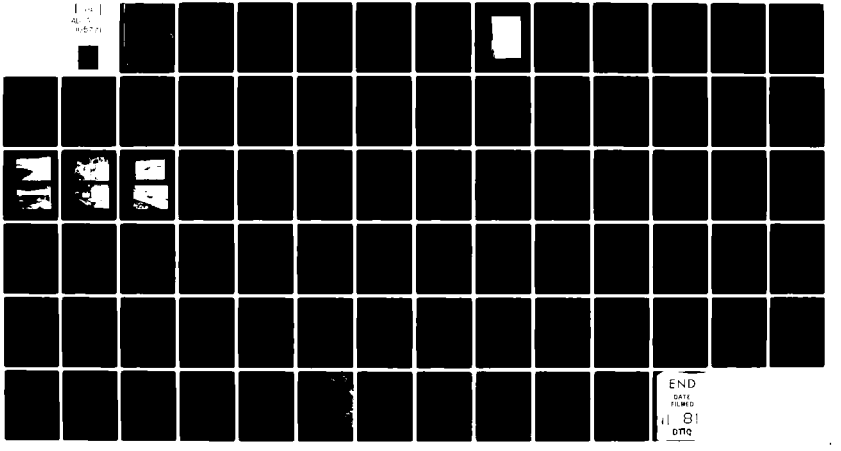

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A105771
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Phase I Inspection Report Cornwall Upper Reservoir Dam Lower Hudson River Basin, Orange County, NY Inventory No. 604	5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) GRANVILLE [illegible]ER, JR. Kester Jr	8. CONTRACT OR GRANT NUMBER(s) DACW51-81-C-0010
9. PERFORMING ORGANIZATION NAME AND ADDRESS Michael Baker, Jr. Inc. 4301 Dutch Ridge Road Box 280 Beaver, PA 15009	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Department of the Army 26 Federal Plaza New York District, CofE New York, New York 10287	12. REPORT DATE 30 June 1981
	13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (If different from Controlling Office) Department of the Army 26 Federal Plaza New York District, CofE New York, NY 10287	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution unlimited.

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

"Original contains color plates: All DTIC reproductions will be in black and white"

18. SUPPLEMENTARY NOTES

National Dam Safety Program. Cornwall Upper Reservoir Dam (Inventory Number NY 604), Lower Hudson River Basin, Orange County, New York. Phase I Inspection Report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability
Cornwall Upper Reservoir Dam
Orange County
Lower Hudson River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and [illegible] on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam and the performance evaluation.

Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
CORNWALL UPPER RESERVOIR DAM
I.D. No. NY 604
DEC DAM No. 195B-1148 LOWER HUDSON RIVER BASIN
ORANGE COUNTY, NEW YORK

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Cornwall Upper Reservoir Dam (I.D. No. NY 604)
State Located:	New York
County Located:	Orange
Stream:	Unnamed Tributary of Moodna Creek
Dates of Inspection:	8 January 1981 11 March 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal conditions which constitute an immediate hazard to human life or property.

Using the Corps of Engineers' screening criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 17 percent of the Probable Maximum Flood (PMF). Therefore, the spillway is adjudged "seriously inadequate," and the dam is assessed as "unsafe, non-emergency."

The "unsafe" classification applied to a dam because of a "seriously inadequate spillway" is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. However, it does mean that, based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity, so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream.

No stability analysis is considered necessary at this time. It is therefore recommended that, within three months of notification of the owner, detailed hydrologic and hydraulic investigations of the structure should be undertaken to more accurately determine the site-specific characteristics of the watershed and their effects upon the overtopping potential of the dam. The results of this investigation and analyses will determine the appropriate remedial measures required to achieve a spillway capacity adequate to discharge the outflow from at least the 1/2 PMF.

In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance must be provided during these periods.

Current inspection and maintenance procedures by the owner are adequate but need to be documented. Monitoring of the reservoir levels should be expanded to include readings during peak flow periods.

The following remedial measures must be completed within one year:

1. Repair the collapsed masonry portion of the left spillway wall and raise the wall and adjacent crest elevation to the average crest elevation. Seed the crest area.

2. Monitor the seep near the left abutment at regular intervals and during periods of high reservoir levels for turbidity and increase in flow, which may indicate potential for the piping of embankment material. If turbidity or increased flows are noted, a qualified geotechnical engineering firm should be retained to develop remedial measures.

3. Remove the trees from the discharge channel.

4. Fill, compact, and seed the low areas on the crest of the dam and the area of erosion near the left abutment.

5. Fill, compact, and seed the rodent holes on the downstream face of the dam.

6. Cut all trees and brush at ground level on the entire embankment. Remove the root systems of all trees with a trunk diameter greater than 3 inches. Fill, grade, compact, and seed all resultant areas of erosion and cavities.

SUBMITTED: Granville Kester, Jr., P.E.
Vice President
MICHAEL BAKER, JR. of New York, INC.

APPROVED: _____
Colonel W.M. Smith, Jr.
New York District Engineer

DATE: 30 JUN 1981

Overall View of Dam
Cornwall Upper Reservoir Dam
I.D. No. NY 604
11 March 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
CORNWALL UPPER RESERVOIR DAM
I.D. No. NY 604
DEC DAM No. 195B-1148
LOWER HUDSON RIVER BASIN
ORANGE COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority - The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection - This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam - Cornwall Upper Reservoir Dam is an earthfill dam with a height of 32.5 feet and a total length of 565 feet. The embankment has a crest width of 8 feet. The side slope of the upstream face of the dam is 1V:1.9H (Vertical to Horizontal), and the average side slope of the downstream face of the dam is 1V:1.7H. The upstream face of the dam is protected by riprap from below the water line to above normal pool level. The reservoir is used as a water supply for the Village of Cornwall-on-the-Hudson, New York.

The spillway, with a crest length of 40.2 feet, is a broad-crested weir located at the right[1] abutment. The foundation for the spillway appears to be cut from a natural stone outcrop. The spillway weir is stone masonry with the center 5-foot section 0.4 foot lower than the adjoining sections.

[1]Looking downstream.

The right training wall is a natural bedrock and placed stone masonry wall beginning at the spillway and extending 100 feet downstream, curving to the left. The left training wall is a placed stone masonry wall beginning at the spillway and extending 25 feet downstream, curving to the left. The discharge channel extends 200 feet downstream and underneath a small bridge (3'x12' opening). The channel is steep with large rocks and accumulations of debris.

The outlet from the reservoir consists of a 12-inch cast iron blow-off pipe and a 6-inch water supply line for the Village of Cornwall-on-the-Hudson, New York. A gate house just beyond the toe of the dam controls the flow of the two lines with valves in the gate house. A 12-inch water supply line extends to a filter building further downstream.

b. Location - Cornwall Upper Reservoir Dam, located on an unnamed tributary of Moodna Creek, is 2 miles south of Cornwall-on-the-Hudson, New York. The reservoir and dam are in Orange County, New York. The coordinates of the dam are N 41° 24.5' and W 74° 00.4'. The dam can be found on the Cornwall, New York, USGS 7.5 minute topographic quadrangle. A Location Map is included in Appendix E.

c. Size Classification - Cornwall Upper Reservoir Dam is 32.5 feet high, and the reservoir storage capacity at the crest of the dam (elevation 964.6 feet M.S.L.) is 222 acre-feet. Therefore, the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams (Reference 15, Appendix D).

d. Hazard Classification - A four-lane highway (U.S. Route 9W) and two homes are located downstream from the dam, 7400 feet and 7800 feet, respectively. The Village of Cornwall is also located downstream from the dam. There is danger of loss of human life from large flows downstream of the dam. Cornwall Upper Reservoir Dam is therefore considered in the "high" hazard category as defined by the Recommended Guildeines for Safety Inspection of Dams.

e. Ownership - The dam and reservoir are owned and operated by the Village of Cornwall-on-the-Hudson, 3 River Avenue, Cornwall-on-the-Hudson, New York, 12520. The contact person is Ralph Smith (Telephone 914-534-5050).

f. Purpose of the Dam - The dam and reservoir are used for water supply.

g. Design and Construction History - No specific design and construction history is available. The dam was originally built around 1912. The designer and contractor are unknown.

Plans for a proposed reconstruction of the spillway and raising of the crest elevation of the dam were prepared by Henry W. Taylor, Consulting Engineer for the Village of Cornwall in 1939. The crest of the dam was raised but the spillway was not enlarged as shown on the plans.

h. Normal Operating Procedures - The reservoir level is normally maintained at the spillway crest elevation. The dam and spillway are visually inspected weekly and the reservoir level is recorded. The valves in the gate house are operated once a year. Maintenance is performed as needed.

1.3 PERTINENT DATA

a. Drainage Area (Acres) -	399.0
b. Discharge at Dam (c.f.s.) -	
Spillway Capacity (at Pool Elev. 966.6 ft. M.S.L.) -	261.0
Reservoir Drain at Normal Pool -	13.0
c. Elevation (Feet above M.S.L.)* -	
Average Top of Dam -	967.7
Minimum Top of Dam -	966.6
Normal Pool (Spillway Crest) -	964.6
Toe of Dam -	934.1
d. Reservoir Surface Area (Acres) -	
Minimum Top of Dam (Elev. 966.6 ft. M.S.L.) -	15.2
Crest of Spillway (Elev. 964.6 ft. M.S.L.) -	14.1

*All elevations are referenced to the spillway crest elevation 964.6 ft. M.S.L., as shown on the plans obtained from the owner.

e. Storage Capacity (Acre-Feet) -

Minimum Top of Dam (Elev. 966.6 ft. M.S.L.) -	222.0
Spillway Crest (Elev. 964.6 ft. M.S.L.) -	193.0

f. Dam

Type - Earth embankment	
Length (Feet) -	565.0
Height (Feet) -	32.5
Top Width (Feet) -	8.0
Side Slopes - Upstream	1V:1.9H
Downstream	1V:1.7H

g. Spillway -

Type - Broad-crested weir	
Crest Length Perpendicular to Flow (Feet) -	40.2
Crest Width Parallel to Flow (Feet) -	3.0
Crest Elevation (Feet M.S.L.) -	964.6

h. Reservoir Drain -

Type: 12-inch cast iron pipe to stream beyond toe of dam.

Control: Manual control valve in the gate house just beyond the toe of the dam.

SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

The Upper Cornwall Reservoir Dam is located in the southern end of the "New England Uplands" physiographic province of New York State. This province is geologically complex and composed characteristically of diverse metamorphic and igneous rock. Bedrock occurring in the immediate vicinity of the dam, as indicated on the Geologic Map of New York (J. G. Broughton and others, 1970), is represented by Precambrian, gray to green quartz-plagioclase gneiss. Granitic gneiss was noted as outcropping on the right abutment of the dam during the visual inspection.

The dam lies on the immediate south or east side of a northeast-southwest trending normal or strike slip fault plane. The fault plane extends along the west shores of Sutherland and Sphagnum Ponds, northeastward past the east end of Storm King Mountain, and across the Hudson River along the Breakneck Brook valley. This entire area has been repeatedly glaciated by the major ice sheet advances which occurred during the Pleistocene Epoch. The most recent ice advance ended approximately 11,000 years ago.

2.2 SUBSURFACE INVESTIGATIONS

Original subsurface information was not available for reference as a part of this investigation. According to the available soils report (preliminary) for Orange County prepared by the Soil Conservation Service, the majority of local surface materials consist of "Scriba stony loam". These soils are described as deep (depth to rock 6 feet), somewhat poorly drained, moderately coarse textured soils developed on firm glacial till. Scriba soils are estimated to have 1.5 feet of slow permeably, gravelly, stony loam overlying a dense, very slowly permeable fragipan extending to a depth of several feet. The fragipan is underlain by gravelly, stony glacial till.

The right abutment/spillway area is reported to contain "Hollis Rock Outcrop association" soils. These soils are shallow (1-2 feet to bedrock), excessively well drained, moderately coarse textured materials formed in low lime glacial till dominated by granitic materials. Bedrock generally outcrops in over 90 percent of the surface areas containing these soils.

2.3 DAM AND APPURTENANT STRUCTURES

Plans for the dam, prepared by Henry W. Taylor, Consulting Engineer for the Village of Cornwall, were available for review during this investigation. The drawings are dated January 1939 and illustrate the original general dam design features as well as planned improvements to increase its height and spillway width. The embankment was raised, but the spillway width was not increased. These drawings are included in Appendix E.

Lacking information to the contrary, the dam is assumed to be comprised of a homogeneous earth embankment. The spillway consists of a 40.2-foot wide rectangular notch excavated through bedrock at the right end of the dam. The spillway contains a masonry weir for reservoir regulation. Both sides of the spillway approach channel are protected by outcropping bedrock. The left side of the spillway control section and immediate discharge channel contains a masonry wing wall for protection of the embankment. Another masonry wing wall protects the right discharge channel downstream of the masonry weir.

Two gate houses are situated immediately downstream of the dam. The one closest to the dam has been adandoned and replaced by the second building. Single 6-inch and 12-inch pipes enter the new gate house. A 12-inch blow-off pipe exits from the gate house and outlets immediately to the stream. A 12-inch water supply pipe leads to the filter house further downstream.

2.4 CONSTRUCTION RECORDS

Construction records were not available for this investigation.

2.5 OPERATING RECORDS

Water levels in the reservoir are measured periodically (at least weekly) and records are kept by Village of Cornwall-on-the-Hudson personnel to monitor water availability. At the same time, visual inspections of the dam are made. The control gates are checked periodically and operated at least once each year. Maintenance is performed as needed.

2.6 EVALUATION OF DATA

The background information collected during this investigation was obtained from Mr. Ralph Smith of the Village

of Cornwall-on-the-Hudson. Available engineering data are considered adequate and reliable for Phase I Inspection purposes, with the exceptions that foundation characteristics are not known and it is unclear if a core wall is present in the embankment (see Plate 3, Appendix E).

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General - The inspection was performed on 8 January 1981. The weather was sunny and the temperature was 10°-20° F. with 2-12 inches of snow on the dam; 2 inches of snow on crest, 4 inches on upstream and downstream faces; and 4 to 8 inches of snow in the spillway. The water surface was 7.5 feet below the spillway crest. Deficiencies found during the inspection will require remedial treatment. A Field Sketch of conditions found during the inspection is included in Appendix F. The complete Visual Inspection Checklist is presented as Appendix B. Because there was a snow cover on the dam during the initial inspection, a follow-up inspection was carried out on 11 March 1981.

b. Spillway - The spillway is at the right abutment. The spillway is a masonry broad-crested weir constructed on bedrock. The center 5 feet of the spillway is 0.4 foot lower than the rest of the spillway and appears to have been constructed for periods of low flow. The right spillway training wall is a natural bedrock and masonry wall 100 feet long, curving to the left. The left spillway training wall is a masonry wall 25 feet long, curving to the left.

c. Embankment - No evidence of sloughing or subsidence was observed on the upstream or downstream slopes. On the upstream face, riprap was in place and no problems were observed. Riprap appears to be dumped rock greater than 5 inches in diameter.

Two local depressions approximately 0.7 foot deep along the crest of the dam, one in the center of the dam, the other 150 feet from the left abutment. The left spillway training wall and the adjacent crest elevation are 0.9 feet below the average crest of the dam. On the downstream slope, there are four or five tree trunks with diameters 4 to 8 inches. Superintendent Ralph Smith reported seepage near a large tree (24-inch diameter) on the downstream face near the left abutment of the dam. No seepage was observed because of the low level of the reservoir and the cold temperature.

d. 11 March 1981 Inspection - The dam was inspected on this date when the dam was free from snow

cover. The reservoir was filled and there was approximately 1 inch of flow over the spillway crest. During this inspection the following items were noted: There is a small eroded area (3 feet wide and 0.5 feet deep) on the downstream face of the dam near the left abutment. The owner's representative had previously reported a seep at the 24-inch diameter tree on the downstream face of the dam near the left abutment. However, during the second inspection, no localized area of seepage was observed; rather, the entire downstream toe along the roadway was wet. The total volume of flow at the lowest point on the toe was approximately 2 gpm. It could not be determined if this flow was the result of seepage through the embankment or runoff from recent snowmelt. There is a large number of trees ranging from 3 inches to 15 inches in diameter growing on the downstream face of the dam below the roadway. The masonry portion of the left spillway wall has collapsed for approximately 3 feet long at the crest of the spillway weir. Two additional depressions were observed on the crest of the dam. One, approximately 2 feet in diameter and 1 foot deep, is located 70 feet from the left spillway training wall. The second is approximately 3 feet long, 1.5 feet wide, and 8 inches deep and is located 20 feet from the left spillway training wall. There are a large number of rodent holes at scattered locations along the downstream face of the dam.

e. Outlet Works - At the toe of the dam is an abandoned gate house. Located 30 feet further downstream is a gate house constructed in the 1940's and is now in use. A 6-inch and 12-inch pipe come into the gate house from the reservoir. A 12-inch blow-off pipe discharges into the stream and a 12-inch water supply line goes to the filter plant further downstream. All pipes are controlled by gate valves in the gatehouse. The valves on the outlet pipes are reported operable.

f. Downstream Channels - The immediate discharge channel for the spillway is mildly sloping and excavated in rock. Large boulders and small trees are located in the channel. A small bridge (opening 3 feet x 12 feet) is located at the toe of the dam and across the discharge channel.

The downstream channel below the outlet is steep and rocky with local accumulations of debris.

Located 7400 feet downstream from the dam is a 4-lane highway (U.S. Route 9W) with a bridge opening 18 feet x 8 feet. Two homes are located 7800 feet downstream from the dam.

g. Reservoir - The reservoir slopes are steep, rocky, and heavily wooded. There were no signs of instability and sedimentation was not reported to be a problem.

3.2 EVALUATION

The visual inspection revealed several deficiencies in this structure. The following items were noted:

1. The left spillway training wall and the adjacent crest elevation are 0.9 feet below the average crest of the dam;

2. Superintendent Ralph Smith reported seepage near a large tree (24-inch diameter) on the downstream face near the left abutment of the dam. Some seepage was observed in this area, but the source could not be determined;

3. Four small local depressions along the crest of the dam.

4. Trees are located in the discharge channel immediately downstream from the spillway;

5. On the downstream slope, there are four or five tree trunks with diameters 4 to 8 inches. On the downstream slope there are a large number of trees below the road;

6. The masonry portion of the left spillway wall has collapsed for approximately 3 feet long at the crest of the spillway weir;

7. A large number of rodent holes are scattered on the downstream face of the dam;

8. There is a small eroded area on the downstream face of the dam near the left abutment.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

There are no formal written instructions for operating the reservoir. The reservoir is normally kept at the spillway crest, but, due to a water shortage in the area, it was 7.5 feet below the crest at the time of inspection.

4.2 MAINTENANCE OF THE DAM

Maintenance of the dam is the responsibility of The Village of Cornwall-on-the-Hudson. Maintenance of the dam is considered to be fair, and is performed as needed. The grass is mowed and some trees are removed each year. Personnel from the water department visit the dam at least once a week to check the reservoir level and visually inspect the dam. The valves to the water supply line and blow-off pipe are operated for tests at least once a year. It is recommended that formal records of examinations and necessary maintenance be recorded for future reference.

4.3 WARNING SYSTEM

At the time of the inspection, there was no warning system or emergency action plan in operation.

4.4 EVALUATION

Past maintenance of the dam and operating facilities appears to have been adequate, but the past activities have gone undocumented except for the water level measurements. A checklist should be compiled by the owner's representative to document the findings made during the periodic inspections and the maintenance items completed. A warning system and emergency action plan should be developed and put into operation.

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SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

Delineation of the watershed of Cornwall Upper Reservoir Dam was made using the USGS quadrangles for Cornwall and West Point, New York. The drainage basin consists of moderate to steep slopes well covered by forests and ground vegetation. Some upland storage exists in the form of flat and swampy areas. The total drainage area is 399 acres.

5.2 ANALYSIS CRITERIA

A hydrologic analysis of the watershed and hydraulic analysis of the dam was conducted using the U.S. Army Corps of Engineers' Flood Hydrograph Package HEC-1 DB computer program (Reference 12, Appendix D). The unit hydrograph was defined using the Snyder's Unit Hydrograph Method. Estimates of Snyder's hydrograph coefficients were developed from average coefficients from the Hydrologic Flood Routing Model for Lower Hudson River Basin (Reference 16, Appendix D). Precipitation data was taken from Hydrometeorological Report No. 33 (Reference 8, Appendix D). Rainfall losses were estimated at an initial loss of 1.0 inch and a constant loss rate of 0.1 inch per hour thereafter. The hydraulic capacity of the dam, reservoir and spillway was determined by incorporating the Modified Puls Routing Method. All flood routings were begun with the reservoir at normal pool level. Outlet discharge capacity was computed by hand. The Probable Maximum Flood (PMF) and 1/2 Probable Maximum Flood (1/2 PMF) were developed and routed through the reservoir.

5.3 SPILLWAY CAPACITY

The spillway capacity at the top of the dam is 261 c.f.s. There is no auxiliary or emergency spillway at Cornwall Upper Reservoir Dam.

5.4 RESERVOIR CAPACITY

The storage capacity of Cornwall Upper Reservoir at normal pool is 193 acre-feet. The storage capacity of the reservoir at the minimum top of dam is 222 acre-feet. Therefore, flood control storage of the reservoir between the spillway crest and top of dam is 29 acre-feet. This volume represents a total of 0.87 inch of runoff from the watershed.

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5.5 FLOODS OF RECORD

No information concerning the effects of significant floods on the dam is available.

5.6 OVERTOPPING POTENTIAL

The maximum capacity of the spillway is 261 c.f.s. before overtopping would occur. The peak outflows of the PMF and 1/2 PMF are 1561 c.f.s. and 768 c.f.s., respectively. Therefore, the spillway is capable of passing 17 percent of the PMF before overtopping would occur.

5.7 RESERVOIR EMPTYING POTENTIAL

The reservoir can be drawn down by means of a 12-inch cast iron outlet pipe. Neglecting inflow, the reservoir can be drawn down from normal pool in approximately 11.5 days. This is equivalent to an approximate drawdown rate of 2.2 feet per day, based on the hydraulic height measured from normal pool divided by the time to dewater the reservoir.

5.8 EVALUATION

Cornwall Upper Reservoir Dam is a "small" size - "high" hazard dam requiring the spillway to pass a flood in the range of the 1/2 PMF to PMF. The PMF and 1/2 PMF were routed through the watershed and dam. It was determined that the spillway is capable of passing 17 percent of the PMF before overtopping the dam. Therefore, the spillway is judged to be "seriously inadequate."

Conclusions pertain to present conditions and the effect of future development on the hydrology has not been considered.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF EMBANKMENT STABILITY

a. Visual Observations - No signs of instability were observed during the visual inspection. Minor problems noted that are related to the stability of the structure include:

1. Four slightly low spots were observed on the crest. These spots may be a result of animal burrowing.

2. Mr. Smith, the owner's representative, reported that there is usually a seep near the 24-inch diameter tree on the left side of the downstream embankment. Some seepage was observed in this area, but the source could not be determined.

b. Design and Construction Data - Design or construction information related to the stability of the structure was not available.

c. Operating Records - According to the owner, the outlets and gates which can be used to drain the impoundment, if necessary, are checked periodically and operated at least once a year. The structure is visually inspected at least weekly when reservoir water level measurements are taken. A rainfall of 2.5 inches in a period of 6 hours reportedly occurred during March 1980 with no structural damage.

d. Post Construction Changes - The height of the dam has been raised (1.5 feet according to available information) since construction.

6.2 STABILITY ANALYSIS

The results of a previous stability analysis, if any, were not available for review during this investigation. Plans for rehabilitation of the dam were available but did not indicate any zoning of the embankment materials or show foundation conditions.

The dam is assumed to be a generally homogeneous embankment composed of sandy silt (ML Group Soil-Unified Classification System). The structure is 32.5 feet high with a crest width of 8 feet. The upstream embankments slopes at 1V:1.9H while the downstream embankment

slope varies between 1V:1.5H and 1V:2H. The dam is subject to rapid drawdown (a drop in reservoir level of more than 0.5 feet/day) in the event the 12-inch outlet is used for dewatering.

The existing upstream and downstream slopes are overly steep, and the crest is narrow. However, no signs of instability were noted in the upstream or downstream slopes of the dam. No stability analysis is considered necessary, based on the overall condition of the dam as observed during the visual inspection.

6.3 SEISMIC STABILITY

Upper Cornwall Reservoir Dam is located in Seismic Zone 1 which presents no hazard from earthquakes, according to the Recommended Guidelines for Safety Inspection of Dams by the Department of the Army, Office of the Chief of Engineers. This determination is contingent on the requirements that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety - Examination of available documents and visual inspections of Cornwall Upper Reservoir Dam did not reveal any conditions which are considered to be hazardous.

Using the Corps of Engineers' screening criteria for review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 17 percent of the PMF. The overtopping of the dam could result in dam failure, increasing the hazard to loss of life downstream. Therefore, the spillway is adjudged "seriously inadequate," and the dam is assessed as unsafe, non-emergency.

The "unsafe" classification applied to a dam because of a "seriously inadequate spillway" is not meant to connote the same degree of emergency as associated with an "unsafe" classification applied for a structural deficiency. However, it does mean that, based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream of the dam.

No signs of instability were noted on the embankment. Therefore, no stability analysis will be required.

b. Adequacy of Information - All evaluations and assessments in this report were based on field observations, conversations with the owner's representative, available engineering data, and office analyses. The information collected is considered adequate for a Phase I Inspection.

c. Need for Additional Information - Detailed hydrologic and hydraulic investigations of the structure are considered necessary to more accurately determine the overtopping potential of the dam.

d. Urgency - The detailed hydrologic and hydraulic investigations must be initiated within three months of notification to the owner. Within one

year, remedial measures as a result of these investigations must be initiated, with completion of these measures during the following year. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance must be provided during these periods. The problem areas listed below must be corrected within one year of notification.

7.2 RECOMMENDED MEASURES

The regular inspections and maintenance procedures presently conducted by the owner's representative appear to be adequate, although some form of documentation is needed. A thorough checklist should be compiled by the owner's representative and completed during each inspection. Maintenance items should be completed annually. Monitoring of the reservoir level should be expanded to include reservoir levels above normal pool. The dam should also be examined during future inspections for any signs of seepage when the reservoir level is at normal pool.

The following remedial measures must be completed within one year:

1. Repair the collapsed masonry portion of the left spillway wall, and raise the wall and adjacent crest elevation to the average crest elevation. Seed the crest area.

2. Monitor the seep near the left abutment at regular intervals and during periods of high reservoir levels for turbidity and increase in flow, which may indicate potential for the piping of embankment material. If turbidity or increased flows are noted, a qualified geotechnical engineering firm should be retained to develop remedial measures.

3. Remove the trees from the discharge channel.

4. Fill, compact, and seed the low areas on the crest of the dam and the area of erosion near the left abutment.

5. Fill, compact, and seed the rodent holes on the downstream face of the dam.

6. Cut all trees and brush at ground level on the entire embankment. Remove the root systems of all trees with a trunk diameter greater than 3 inches. Fill, grade, compact, and seed all resultant areas of erosion and cavities.

APPENDIX A

PHOTOGRAPHS

CONTENTS

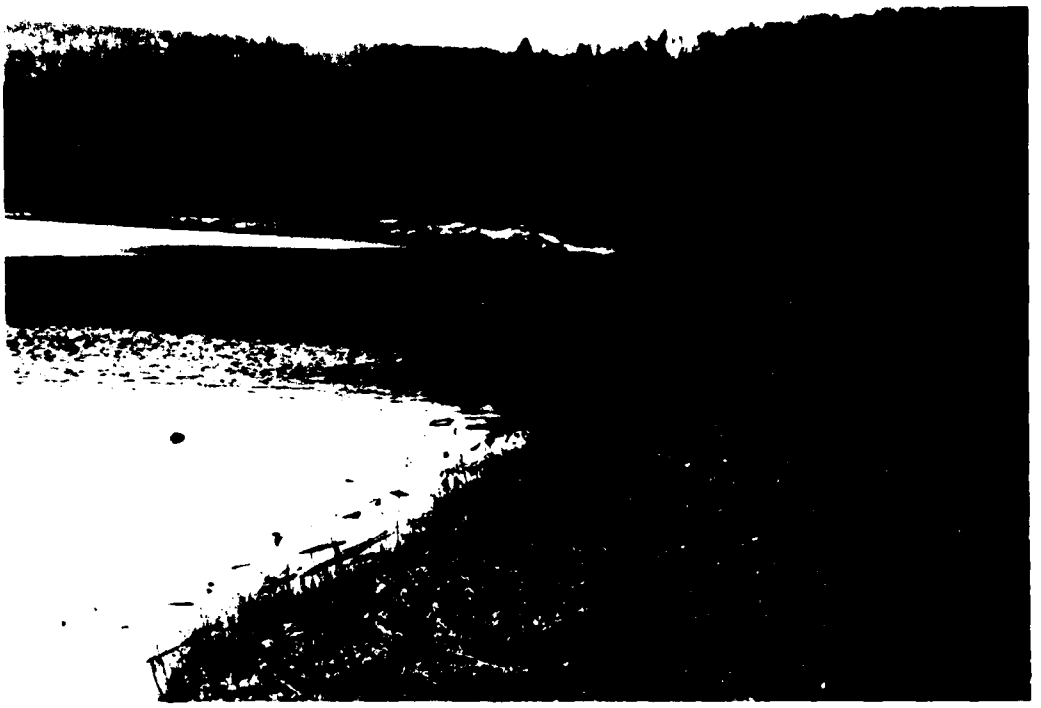


Photo 1. Upstream Face of Dam
11 March 1981

Photo 2. Spillway from Right Abutment (Looking Upstream)
8 January 1981

Photo 3. View of Spillway from Discharge Channel
11 March 1981

Photo 4. Gatehouse and 12-Inch Blow-Off Pipe Outlet
(Looking Upstream)
8 January 1981

Photo 5. View of Downstream Face of Dam
from Left Abutment
11 March 1981

Photo 6. View of Valve House from Crest of Dam
11 March 1981

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Cornwall Upper Reservoir Dam

Fed. I.D. # NY 604 DEC Dam No. 195B-1148

River Basin Lower Hudson River

Location: Town Cornwall County Orange

Stream Name Unnamed

Tributary of Moodna Creek

Latitude (N) 41°24.53' Longitude (W) 74°00.43'

Type of Dam Earth embankment

Hazard Category High

Date(s) of Inspection 8 January 1981

Weather Conditions Sunny, 15°F.

Reservoir Level at Time of Inspection 957.0 ft. M.S.L.

b. Inspection Personnel Wayne D. Lasch, Gary W. Todd, Rory L. Galloway

c. Persons Contacted (Including Address & Phone No.)

Ralph Smith, Village Hall

3 River Avenue

Cornwall-on-the-Hudson, NY 12520

914/534-5050

d. History:

Date Constructed 1912 Date(s) Reconstructed About 1939

Designer Unknown

Constructed By Unknown

Owner Village of Cornwall-on-the-Hudson, NY

2) Embankment

a. Characteristics

(1) Embankment Material Sandy silt.

(2) Cutoff Type None

(3) Impervious Core Information not available.

(4) Internal Drainage System None observed

(5) Miscellaneous

b. Crest

(1) Vertical Alignment Local depressions along crest (Sta. 1+50 and 2+70).

(2) Horizontal Alignment Good

(3) Surface Cracks None observed at time of inspection.

(4) Miscellaneous Snow covered at time of inspection (2-12 in.).

c. Upstream Slope

(1) Slope (Estimate) (V:H) 1:1.9

(2) Undesirable Growth or Debris, Animal Burrows Scattered vegetation on upstream face with small trees and stumps (trunk dia. less than 3 in.

(3) Sloughing, Subsidence, or Depressions None observed at time of inspection.

(4) Slope Protection Riprap was in place and no problems were observed. Riprap appears to be dumped rock greater than 5 in. diameter.

(5) Surface Cracks or Movement at Toe Could not be observed because of ice surface.

d. Downstream Slope

(1) Slope (Estimate - V:H) 1:1.7 (average), 14 ft. berm on downstream face for access road.

(2) Undesirable Growth or Debris, Animal Burrows Trees and stumps on downstream slope. (One 24 in. tree and several stumps 6 in. diameter.)

(3) Sloughing, Subsidence or Depressions None observed at time of inspection.

(4) Surface Cracks or Movement at Toe None observed at time of inspection.

(5) Seepage The owner's representative reported that seepage occurs near the 24 in. diameter tree on the downstream slope near the left abutment.

(6) External Drainage System (Ditches, Trenches, Blanket) None

(7) Condition Around Outlet Structure Well drained; no erosion noted.

(8) Seepage Beyond Toe None observed at time of inspection.

e. Abutments - Embankment Contact The junction of the embankment/abutment was in good condition at the time of inspection.

(1) Erosion at Contact None observed at time of inspection.

(2) Seepage Along Contact None observed at time of inspection.

3) Drainage System

a. Description of System None

b. Condition of System None

c. Discharge from Drainage System None

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) None

5) Reservoir

a. Slopes Reservoir slopes are moderate to steep but are well covered by forests.

b. Sedimentation Sedimentation is not reported to be a problem.

c. Unusual Conditions Which Affect Dam None observed at time of inspection.

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) 4-lane highway (9W) located 7,400 ft. downstream, economic damage to 2 homes 7,800 ft. downstream. The Village of Cornwall-on-the-Hudson is also downstream from the dam.

b. Seepage, Unusual Growth None observed at time of inspection.

c. Evidence of Movement Beyond Toe of Dam None observed at time of inspection.

d. Condition of Downstream Channel Small bridge (3 ft. x 12 ft.) at toe. Channel was steep and rocky with local accumulations of debris.

7) Spillway(s) (Including Discharge Conveyance Channel)

Stone masonry broad-crested weir spillway.

a. General Gently sloped riprap-lined approach channel with placed stone masonry spillway and training walls placed on bedrock. Training walls are masonry.

b. Condition of Service Spillway Good condition. No erosion or major deterioration noted.

c. Condition of Auxiliary Spillway None

d. Condition of Discharge Conveyance Channel Narrow and confined drainage with large boulders and trees present within channel.

8) Reservoir Drain/Outlet

Type: Pipe _____ Conduit X Other _____

Material: Concrete _____ Metal cast iron Other _____

Size: 12 in. Length Unknown

Invert Elevations: Entrance Not observed

Exit 928.4 ft.

Physical Condition (Describe): Unobservable Discharge end observable.

Material: Cast iron was clean with little rust or scale.

Joints: Good Alignment Good

Structural Integrity: Appears to be in good condition.

Hydraulic Capability: Appears adequate for intended use.

Means of Control: Gate _____ Valve X Uncontrolled _____

Operation: Operable X Inoperable _____ Other _____

Present Condition (Describe): Owner reports valves are operated once a year.

9) Structural - Not Applicable

a. Concrete Surfaces

b. Structural Cracking

c. Movement - Horizontal & Vertical Alignment (Settlement)

d. Junctions with Abutments or Embankments

e. Drains - Foundation, Joint, Face _____

f. Water Passages, Conduits, Sluices _____

g. Seepage or Leakage _____

h. Joints - Construction, etc. _____

i. Foundation _____

j. Abutments _____

k. Control Gates _____

l. Approach & Outlet Channels _____

m. Energy Dissipators (Plunge Pool, etc.) _____

n. Intake Structures _____

o. Stability _____

p. Miscellaneous _____

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition Abandoned gatehouse at toe of dam is brick in fair condition. 30 ft. downstream is a brick gatehouse presently in use. Valves are in the gatehouse to control the water supply line and blow-off line.

APPENDIX C

HYDROLOGIC/HYDRAULIC ENGINEERING DATA AND COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject CORNWALL UPPER RESERVOIR S.O. No. _____
DAM Sheet No. _____ of _____
APPENDIX C - HYDRAULIC/HYDROLOGIC CALC Drawing No. _____
Computed by _____ Checked by _____ Date _____

SUBJECT	PAGE

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

		Elevation * (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1)	Top of Dam	966.6	15.2	222.
2)	Design High Water (Max. Design Pool)	Unknown	-	-
3)	Auxiliary Spillway Crest	None	-	-
4)	Pool Level with Flashboards	None	-	-
5)	Service Spillway Crest	964.6	14.1	193.

DISCHARGES

		Volume (cfs)
1)	Average Daily	Unknown
2)	Spillway @ Maximum High Water - Top of Dam -	261.
3)	Spillway @ Design High Water	Unknown
4)	Spillway @ Auxiliary Spillway Crest Elevation	None
5)	Low Level Outlet	13.
6)	Total (of all facilities) @ Maximum High Water	274.
7)	Maximum Known Flood	Unknown
8)	At Time of Inspection	0

*All elevations are referenced to the spillway crest elevation 964.6 ft. M.S.L., as shown on the plans obtained from the owner.

CREST: ELEVATION: 966.6 ft.

Type: Earth Embankment.

Width: 8 ft. Length: 565 ft.

Spillover Broad-crested weir

Location Right abutment.

SPILLWAY:

SERVICE		AUXILIARY
964.6 ft.	Elevation	None
Broad-crested weir	Type	-
X	Width	-
	Type of Control	
-	Uncontrolled	-
	Controlled:	
-	Type (Flashboards; gate)	-
-	Number	-
-	Size/Length	-
	Invert Material	-
	Anticipated Length of Operating Service	-
-	Chute Length	-
0.6 ft.	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	-

HYDROMETEROLOGICAL GAGES:

Type: None

Location:

Records:

Date:

Max. Reading:

FLOOD WATER CONTROL SYSTEM:

Warning System: None

Method of Controlled Releases (mechanisms):

12 in. cast iron blow-off pipe at toe of dam.

DRAINAGE AREA: 399 ac.

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Forest

Terrain - Relief: Moderate to steep slopes.

Surface - Soil: Well drained.

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

There were no known plans for altering the existing runoff patterns at the time of the inspection.

Potential Sedimentation problem areas (natural or man-made; present or future)

None observed, all slopes well vegetated.

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

None observed at the time of inspection.

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

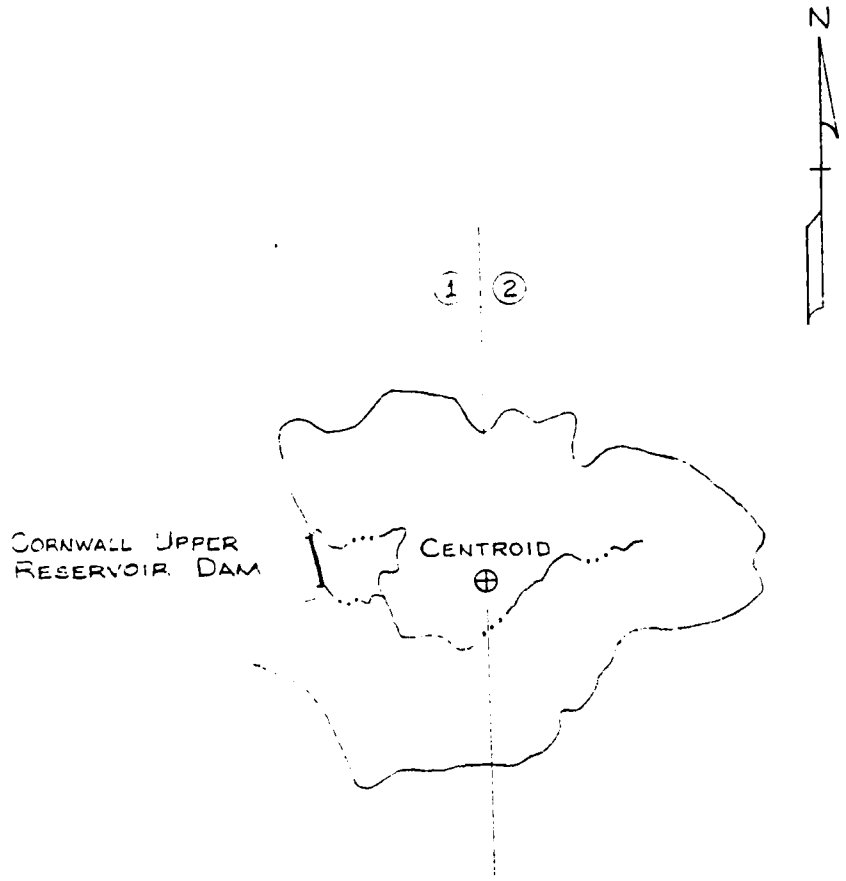
Location: None

Elevation:

Reservoir:

Length @ Maximum Pool 1,550 ft.

Length of Shoreline (@ Spillway Crest) 3,850 ft. (0.73 mi.)



QUADS : ① CORNWALL, N.Y.
② WEST POINT, N.Y.

DRAINAGE AREA = 0.62 SQ. MI.

DRAINAGE AREA ABOVE
CORNWALL UPPER
RESERVOIR DAM

SCALE : 1 IN. = 2000 FT.

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Subject [illegible]
[illegible] S.O. No.
Sheet No. 6 of 26
Drawing No.
Computed by [illegible] Checked by [illegible] Date [illegible]

HYDROLOGIC AND HYDRAULIC DATA

DRAINAGE AREA ABOVE DAM = 4.24 SQ. IN. (MEASURED ON CORNWALL AND WEST POINT, N.Y. QUADS) = 0.633 SQ. MI.

L_{CA} = 2800 FEET = 0.53 MI.

L = 6700 FEET = 1.27 MI.

STORAGE COMPUTATIONS

SURFACE AREA AND ELEVATION MEASUREMENTS (FROM [illegible])

ELEVATION (FT.)	AREA (ACRES)
964.6	14.08
980	22.65
1000	41.63
1020	67.03

$T_p = C_T (L \times L_{CA})^{.3}$

$C_p = 0.63 \qquad C_T = 2.0$

$T_p = 2.0[(1.27)(0.53)]^{.3}$
$= 1.78$

$A & $E cards
for use in dewatering dock

Elev. (ft.)	Surface Area (Ac.)	Storage Capac. (Ac-Ft)
939.6	4.13	0
956.6	8.40	104.41*
964.6	14.08	193.35*
980	22.65	280.22
1000	41.63	633.25

* Known storage values @ these elevations

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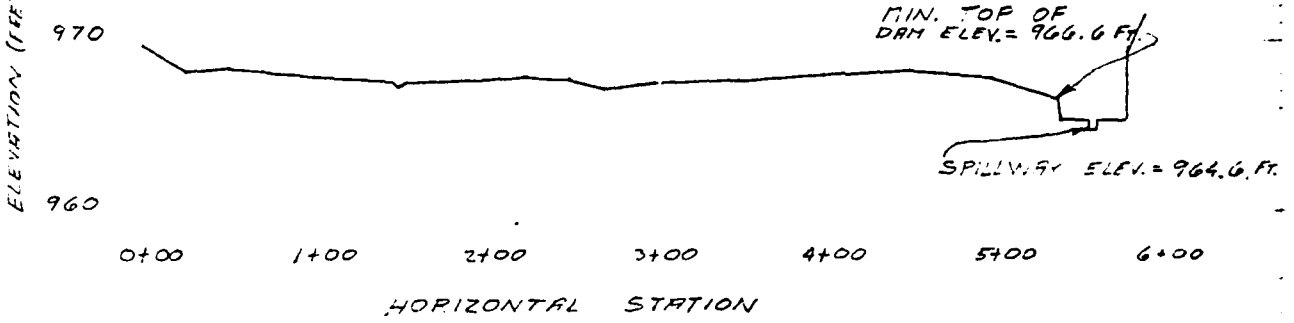
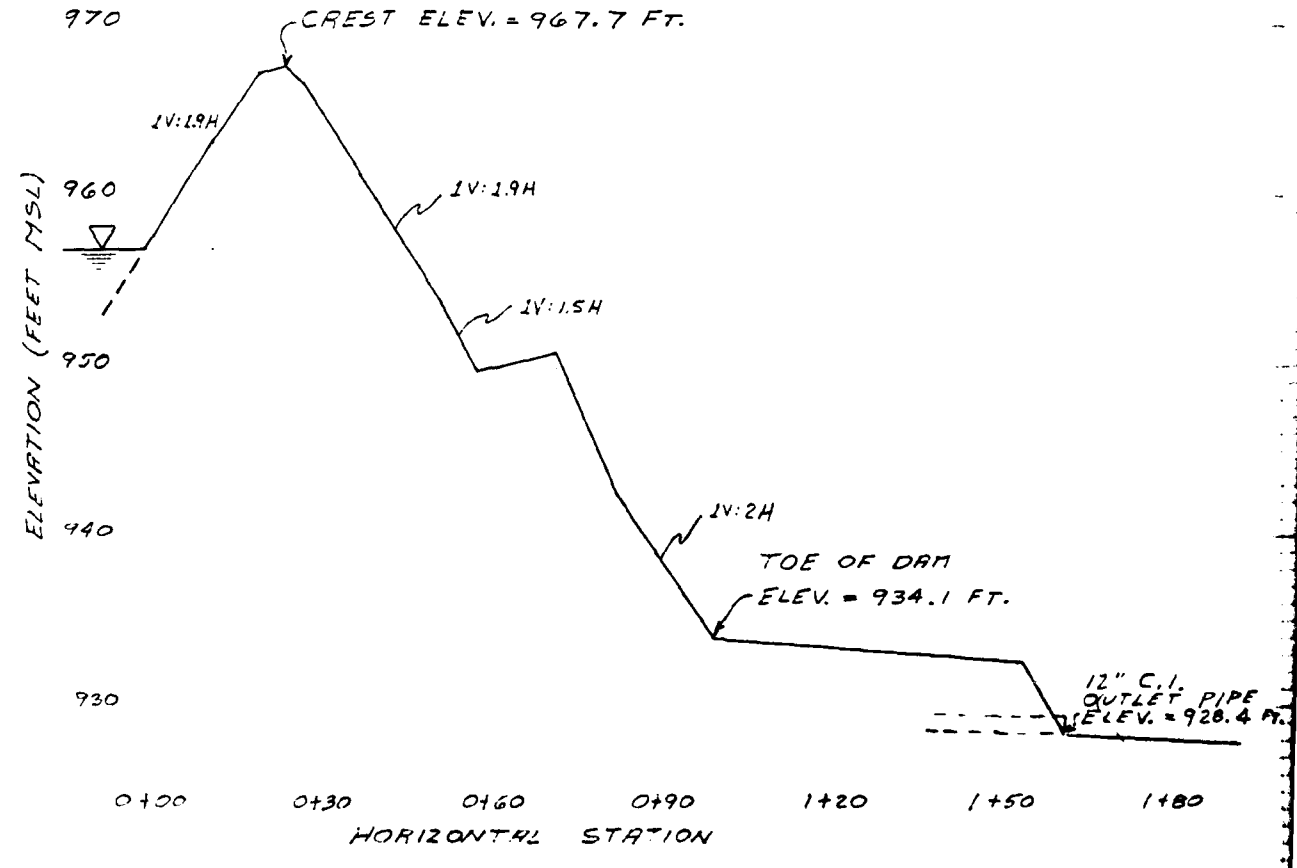
Subject UPPER CONNOQUENESSING RESERVOIR DAM S.O. No.
TOP OF DAM PROFILE AND CROSS SECTION Sheet No. 7 of 26
Drawing No.
Computed by SMT Checked by RJR Date JAN. 14, 1981

TOP OF DAM PROFILE : (LOOKING DOWNSTREAM)

LENGTH = 565 FT.



CROSS SECTION AT STA. 2+21



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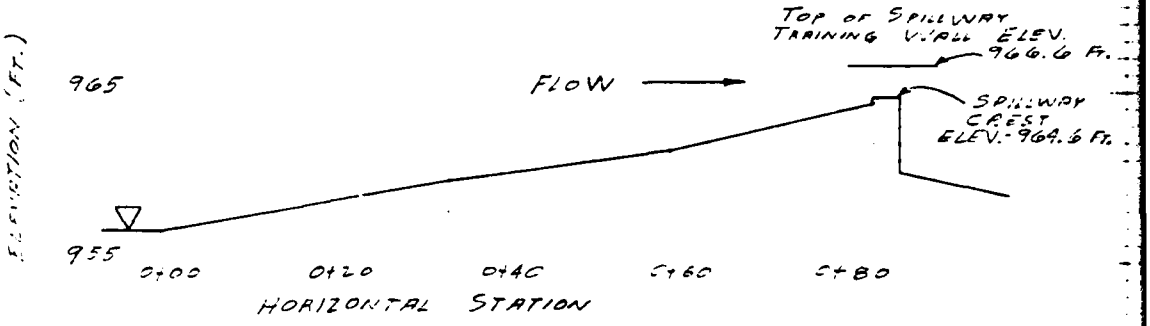
Subject COLLEGE UPPER RESERVOIR DAM S.O. No. _____
SPILLWAY DISCHARGE RATING
Sheet No. 8 of 26
Drawing No. _____
Computed by GWT Checked by RAB Date MAR. 15, 1981

PROFILE DOWN SPILLWAY



DEVELOP RATING CURVE BASED UPON CRITICAL FLOW OVER SPILLWAY:

$V = \sqrt{gD}$ (CHOW, OPEN FLOW HYDRAULICS, P. 43)

$g = 32.2$ FT/SEC^2

D = MEAN HYDRAULIC DEPTH = $\frac{\text{FLOW AREA}}{\text{FREE SURFACE TOP WIDTH}} = \frac{A}{T}$

V = MEAN FLOW VELOCITY

$Q = AV$

SPILLWAY ELEVATION, (FT)	FLOW DEPTH, (FT)	AREA, (FT^2)	TOPWIDTH, (FT)	A/T	V, FT/SEC	Q (CFS)	$V^2/2g$	RESERVOIR SURFACE, (FT)
964.6	0	0	5.0	0	0	0	0	964.6
965.0	0.4	2.0	5.0	0.4	3.59	7.18	0.20	965.2
965.6	1.0	26.1	40.2	0.65	4.57	119.34	0.32	965.9
966.1	1.5	46.2	40.2	1.15	6.08	281.05	0.57	966.7
966.6	2.0	66.3	40.2	1.64	7.29	483.15	0.82	967.4
967.1	2.5	86.4	40.2	2.15	8.32	718.76	1.07	968.2
967.6	3.0	106.5	40.2	2.65	9.24	983.65	1.32	968.9
968.1	3.5	126.6	40.2	3.15	10.07	1275.02	1.57	969.7
968.6	4.0	146.7	40.2	3.65	10.84	1590.39	1.82	970.4
969.1	4.5	166.8	40.2	4.15	11.56	1928.18	2.07	971.2

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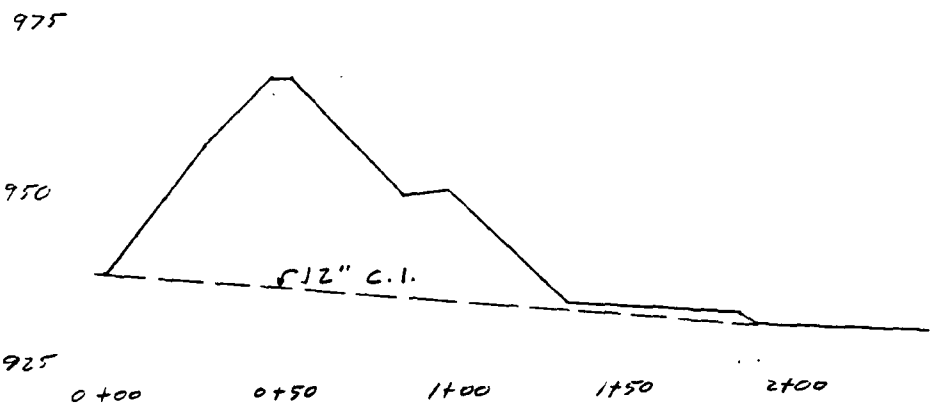
Subject UPPER CORNWALL RESERVOIR DAM S.O. No. 11-02
12" DIA PIPE RATING Sheet No. 9 of 26
Drawing No.
Computed by GWT Checked by WLS Date 1-19-81



SPILLWAY CREST ELEVATION - 964.6 FT.
INLET ELEVATION - 939.6 FT. (ESTIMATED)
OUTLET ELEVATION - 928.4 FT.
LENGTH OF 12" CAST IRON PIPE - 195 FT. (ESTIMATED)
PIPE DIA = 12" CAST IRON

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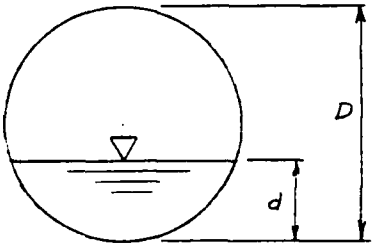
Subject UPPER CORNWALL RESERVOIR DAM S.O. No.
12" DIA. PIPE RATING Sheet No. 10 of 26
Drawing No.
Computed by GWT Checked by WLS Date 1-19-81

"DESIGN OF SMALL DAMS" PG. 558 AND 559



D = DIA. PIPE
d = DEPTH OF WATER
S = PIPE SLOPE
$= \frac{939.6 - 928.4}{195'} = 0.057'$

$\frac{d}{D} = \frac{.5}{1} = .5$ TABLE B-2 $1.3955' = \frac{Q_c}{D^{5/2}} = \frac{Q}{1^{5/2}}$ $Q = 1.39'$ CFS

$\frac{d}{D} = \frac{.5}{1} = .5$ TABLE B-3 $.232' = \frac{Q_n}{D^{8/3} S^{1/2}} = \frac{Q(0.013)}{1^{8/3}(0.057)^{1/2}}$ $Q = 4.26'$ CFS

$\frac{d}{D} = \frac{.75}{1} = .75$ TABLE B-2 $3.0607' = \frac{Q_c}{D^{5/2}} = \frac{Q}{1^{5/2}}$ $Q = 3.06'$ CFS

$\frac{d}{D} = \frac{.75}{1} = .75'$ TABLE B-3 $.422' = \frac{Q_n}{D^{8/3} S^{1/2}} = \frac{Q(.013)}{1^{8/3}(.057)^{1/2}}$ $Q = 7.75'$ CFS

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Subject CORNWALL UPPER RESERVOIR DAM S.O. No.
12" DIA PIPE RATING Sheet No. 11 of 26
Drawing No.
Computed by GWT Checked by HLB Date 1-19-81

ORIFICE FLOW

$Q = CA(2gH)^{.5}$.

$= .60 \times .785 \times (64.4\,H)^{.5}$

$= 3.78\,H^{.5}$

$A = \pi R^2 = \pi(.5)^2 = 0.785$ FT^2

$g = 32.2$ FT/SEC^2

H VARIES FROM 0.9 FT TO 24.5 FT. AND IS MEASURED TO THE CENTER OF THE PIPE

C = .60 FROM TABLE 4-6 PG. 4-32 BRATER & KING

d = 1 FT L = 795 FT.

ELEVATION (FT)	C	A (Sq. Ft.)	$2g$ (FT/SEC^2)	H (FT)	Q (CFS)	
940.6	.60	.785	64.4	0.5	2.67	
941.0	.60	.785	64.4	0.9	3.59	
942.0	.60	.785	64.4	1.9	5.21	
943.0	.60	.785	64.4	2.9	6.44	
944.0	.60	.785	64.4	3.9	7.46	
945.0	.60	.785	64.4	4.9	8.37	↓ Orifice Control
946.0	.60	.785	64.4	5.9	9.18	
947.0	.60	.785	64.4	6.9	9.93	
948.0	.60	.785	64.4	7.9	10.62	
949.0	.60	.785	64.4	8.9	11.28	
950.0	.60	.785	64.4	9.9	11.89	
951.0	.60	.785	64.4	10.9	12.48	
952.0	.60	.785	64.4	11.9	13.04	
953.0	.60	.785	64.4	12.9	13.58	
954.0	.60	.785	64.4	13.9	14.09	
955.0	.60	.785	64.4	14.9	14.59	
956.0	.60	.785	64.4	15.9	15.07	
957.0	.60	.785	64.4	16.9	15.54	
958.0	.60	.785	64.4	17.9	15.99	
959.0	.60	.785	64.4	16.9	16.43	
960.0	.60	.785	64.4	19.9	16.86	
961.0	.60	.785	64.4	20.9	17.28	
962.0	.60	.785	64.4	21.9	17.69	
963.0	.60	.785	64.4	22.9	18.09	
964.0	.60	.785	64.4	23.9	18.48	
964.6	.60	.785	64.4	24.5	18.71	

Pipe Control (See next Page)

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Box 280
Beaver, Pa. 15009

Subject CORNWALL UPPER RESERVOIR DAM S.O. No. _____
12" PIPE RATING Sheet No. 12 of 26
_____ Drawing No. _____
Computed by GWT Checked by MP Date 1-19-81

PIPE FLOW

$$Q = \frac{A(2gH)^{1/2}}{[1 + K_e + K_b + K_c(L)]^{1/2}}$$

$$= \frac{.785(2 \times 32.2 \times H)^{1/2}}{[1 + .78 + 0 + .0313(195)]^{1/2}}$$

$$Q = 2.24\ H^{1/2}$$

$A = \pi R^2 = \pi(.5)^2 = 0.785\ FT^2$
$g = 32.2\ FT/SEC^2$
H VARIES AND IS MEASURED FROM THE TOP OF PIPE ELEV. AT THE OUTLET.
$L = 195\ FT.$
$K_e (K_o) = .78$ P_g 5.5-6 SCS NEH-5
$K_b (K_s) = 0$ P_G 5.5-10 SCS NEH-5
$K_c (K_p) = .0313$ P_G 5.5-4 SCS NEH-5
$n = 0.013$
TOP OF 12" CAST IRON PIPE AT OUTLET = EL. 929.4 FT.

ELEVATION (FT)	H (FT)	Q (CFS)
941.0	11.6	7.63
942.0	12.6	7.95
943.0	13.6	8.26
944.0	14.6	8.56
945.0	15.6	8.85
946.0	16.6	9.13
947.0	17.6	9.40
948.0	18.6	9.66
949.0	19.6	9.92
950.0	20.6	10.17
951.0	21.6	10.41
952.0	22.6	10.65
953.0	23.6	10.88
954.0	24.6	11.11
955.0	25.6	11.33
956.0	26.6	11.55
957.0	27.6	11.77
958.0	28.6	11.98
959.0	29.6	12.19
960.0	30.6	12.39
961.0	31.6	12.59
962.0	32.6	12.79
963.0	33.6	12.98
964.0	34.6	13.18
964.6	35.2	13.29

Orifice (control) (See preceding page)

PIPE CONTROL

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Cornwall Upper Res. Dam S.O. No. _____
Combined Sheet No. 13 of 26
Outlet Rating Curve Drawing No. _____
Computed by JLS Checked by _____ Date 7/10/81

Elev. (Ft.)	Pipe Less than Full (cfs)	Pipe Full		Controlling Q (cfs)
		Orifice (cfs)	Pipe Flow (cfs)	
939.6	0			0
940.1	1.4			1.4
940.4	3.1			3.1
941.0		3.6		3.6
942.0		5.2		5.2
944.0		7.5	8.6	7.5
945.0		8.4	8.9	8.4
946.0		9.2	9.1	9.1
946.0			9.7	9.7
950.0			10.2	10.2
954.0			11.1	11.1
958.0			12.0	12.0
962.0			12.8	12.8
964.0			13.2	13.2
964.6			13.3	13.3

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

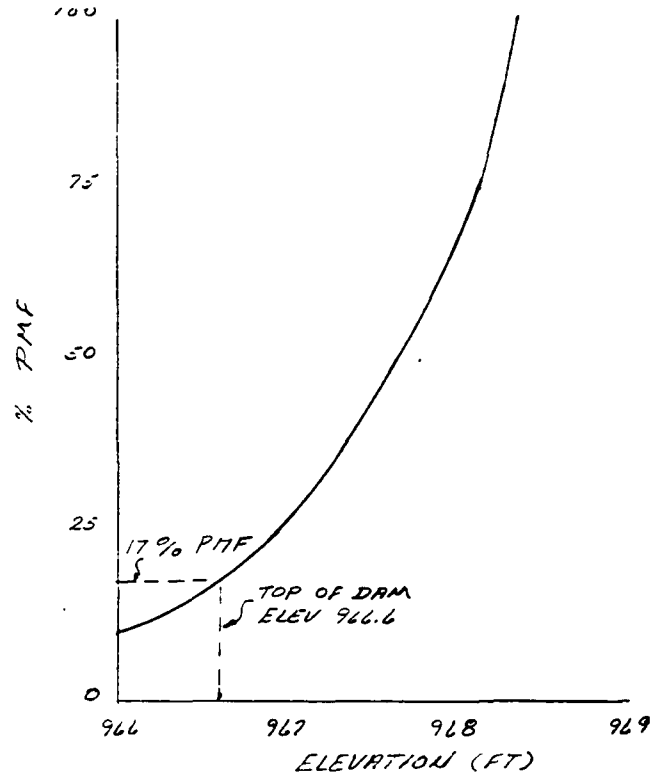
Box 280
Beaver, Pa. 15009

Subject CORNWALL UPPER RESERVOIR DAM. S.O. No. _____

SPILLWAY CAPACITY ANALYSIS Sheet No. 14 of 26

_____ Drawing No. _____

Computed by RAB Checked by _____ Date 02/11/81



```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1973
  LAST MODIFICATION  26 FEB 79
  HBJ UPDATE         04 JUN 79
**********
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Flood Routing

```
    1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF CORNWALL UPPER RESERVOIR DAM
    3              A3       UNIT HYDROGRAPH BY SNYDERS METHOD
    4              B    600         0       20        0        0        0        0        0       -4        0
    5              B1     5
    6              J      1         5        1
    7              J1   1.0      0.75      0.5     0.25     0.10
    8              K      0         1                                      1
    9              K1       ROUTED HYDROGRAPH TO DAM
   10              M      1         1    0.623
   11              P                21.5      111      123      133      142
   12              T                                                   1.0      0.1
   13              W    1.75      .65
   14              X    -1.0     -0.25      2.0
   15              K      1         2                                      1
   16              K1       ROUTING FOR CORNWALL UPPER RESERVOIR DAM
   17              Y                                      1        1
   18              Y1     1                                                -964.0       -1
   19              Y4 964.5     965.2     965.9     966.7     967.4     968.2     968.9     969.7     970.4     971.2
   20              Y5     0       7.2       119.3     281.0     484.1     718.8     983.0    1271.6    1580.4    1926.2
   21              $A   4.13      8.40     14.08     22.65     41.63
   22              $E 939.0     956.0     964.6     980       1000
   23              $$ 964.5
   24              $O 966.5      3.38      1.5       525
   25              $L     0        15        90       380       510       525       530       530
   26              $V 965.5     967.0     967.5     968.0     968.5     969.0     969.5     970.0
   27              K     99
```

SHEET 15 OF 46

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
  HBJ UPDATE         04 JUN 79
**********

RUN  DATE 02/16/91
     TIME    10.16

                    NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
                    HYDROLOGIC AND HYDRAULIC ANALYSIS OF CUMBERLAND UPPER RESERVOIR DAM
                    UNIT HYDROGRAPH BY SNYDERS METHOD

                                        JOB SPECIFICATION
          NQ     NDA     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT    NSTAN
         600       1       20        0       0        0        0        0       -6        0
                                   JOPER      NW   LROPT   TRACE
                                       5       0       0       0       0

                                MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 1  NRTIO= 5  LRTIO= 1
                RTIOS=   1.00   0.75   0.50   0.25   0.10

**********      **********      **********      **********      **********

                                    SUB-AREA RUNOFF COMPUTATION

                RUNOFF HYDROGRAPH TO DAM

                          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                              1       0       0       0       0       0       1       0       0

                                        HYDROGRAPH DATA
                IHYDG    IUHG   TAREA    SNAP   IPSDA   IRSPC   RATIO   ISAME   ISAME   LOCAL
                    1       1   0.62     0.0     0.62    0.0     0.0        0       0       0

                                        PRECIP DATA
                          SPFE     PAS      R6      R12     R24     R48     R72     R96
                           0.0    21.30   111.00  123.00  133.00  142.00   0.0     0.0
IRSPC COMPUTED BY THE PROGRAM IS 0.300

                                        LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0     0.0     0.0    1.00     0.0     0.0    1.00    1.00    0.10     0.0     0.0

                                    UNIT HYDROGRAPH DATA
                                    TP=  1.78   CP=0.63   NTA=  6

                                    RECESSION DATA
                                STRTQ=   -1.50   QRCSN=   -0.05   RTIOR= 2.00

          UNIT HYDROGRAPH 29 END-OF-PERIOD ORDINATES, LAG=  1.80 HOURS, CP= 0.63  VOL= 1.00
          10.     37.     72.    106.    133.    142.    131.    108.     80.     54.
          38.     27.     38.     31.     25.     21.     17.     13.     11.      9.
           7.      5.      5.      4.      3.      3.      2.      2.      1.
```

0 END-OF-PERIOD FLOW
40.04 HR.MN PERIOD RAIN EXCS LOSS COMP Q 40.04 HR.MN PERIOD RAIN EXCS LOSS COMP Q

SUB 24.20 20.49 3.71 [illegible]
[illegible] 5660.11 29.11 [illegible]

****

HYDROGRAPH ROUTING

ROUTING FOR CORNWALL UPPER RESERVOIR DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

ITPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-965.	-1

STAGE	964.60	965.20	965.90	966.70	967.40	968.20	969.00	969.70	970.40	971.20
FLOW	0.0	7.20	119.30	281.00	483.10	718.00	983.00	1279.00	1596.40	1920.20

SURFACE AREA= 4. 8. 14. 23. 42.

CAPACITY= 0. 104. 193. 474. 1107.

ELEVATION= 940. 957. 965. 980. 1000.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
964.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
966.6	3.1	1.5	525.

CREST LENGTH	0.	15.	90.	389.	910.	525.	525.	525.	
AT OR BELOW ELEVATION	966.6	967.0	967.5	968.0	968.5	969.0	969.5	970.0	

PEAK OUTFLOW IS 1561. AT TIME 41.33 HOURS

PEAK OUTFLOW IS 1167. AT TIME 41.33 HOURS

PEAK OUTFLOW IS 768. AT TIME 41.67 HOURS

PEAK OUTFLOW IS 357. AT TIME 42.00 HOURS

PEAK OUTFLOW IS 134. AT TIME 42.33 HOURS

SHEET 17 OF 26

****

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
				RATIOS APPLIED TO FLOWS				
				1.00	0.75	0.50	0.25	0.10
HYDROGRAPH AT	1	3.02	1	1508.	1170.	784.	392.	157.
		(1.61)		(44.41)	(33.30)	(22.20)	(11.10)	(4.44)
ROUTED TO	2	3.02	1	1501.	1167.	768.	357.	139.
		(1.61)		(44.19)	(33.04)	(21.75)	(10.12)	(3.79)

Sheet 18 of 26

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	964.00	969.00	980.33
STORAGE	193.	193.	222.
OUTFLOW	0.	0.	251.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	983.33	1.75	250.	1501.	8.33	41.33	0.0
0.75	983.13	1.53	246.	1167.	7.00	41.33	0.0
0.50	981.79	1.19	241.	763.	5.67	41.67	0.0
0.25	980.95	0.35	228.	327.	3.00	42.00	0.0
0.10	980.97	0.0	213.	139.	0.0	42.33	0.0

Sheet 19 of 36

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
  ABJ UPDATE         04 JUN 79
**********
    1              A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2              A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF CORNWALL UPPER RESERVOIR DAM
    3              A3       DEWATERING ANALYSIS OF CORNWALL UPPER RES. DAM
    4              B    100         3         0         0         0         0         0         0         0         0
    5              B1     3
    6              J      1         1         1
    7              J1     1
    8              K                1                                                  1
    9              K1       HOLE RUNOFF HYDROGRAPH TO DAM
   10              Y      -1                0.62                0.62                                        1
   11              N
   12              N
   13              N
   14              N
   15              N
   16              N
   17              N
   18              N
   19              N
   20              N
   21              K      1         2                                                  1
   22              K1       DEWATERING CORNWALL UPPER RES. DAM
   23              Y                                            1         1
   24              Y1     1                                                  -964.6        -1
   25              Y4   939.5     940.1     940.4       941       942       944       945       946       948       950
   26              Y4     955       958       962       964     964.6
   27              Y5       0       1.4       3.1       3.6       5.2       7.5       8.4       9.1       9.7      10.2
   28              Y5    11.1      12.0      12.8      13.2      13.3
   29              $A    4.13      8.43     14.08     22.65     41.63
   30              $E   939.5     956.5     964.6       980      1000
   31              $$   964.6
   32              $D   966.0      3.08       1.5       525
   33              K      99
```

Sheet 20 of 26

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*********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  26 FEB 79
   MOD UPDATE         04 JUL 79
*********************************

RUN  DATE 02/11/81
     TIME    09.06


                 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
                 HYDROLOGIC AND HYDRAULIC ANALYSIS OF CORNWALL UPPER RESERVOIR DAM
                 DEWATERING ANALYSIS OF CORNWALL UPPER RES. DAM

                              JOB SPECIFICATION
     NQ     NHR    NMIN    IDAY    IHR    IMIN   METRC    IPLT    IPRT   NSTAN
    100       3       0       0      0       0       0       0       0       0
                            JOPER    NWT   LROPT   TRACE
                               5       0       0       0       0

                         MULTI-PLAN ANALYSES TO BE PERFORMED
                           NPLAN= 1 NRTIO= 1 LRTIO= 1
      RTIOS=    1.00


   **********     **********     **********     **********     **********

                           SUB-AREA RUNOFF COMPUTATION

          NULL RUNOFF HYDROGRAPH TO DAM

               ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                   1       0       0       0       0       0       1       0       0

                                  HYDROGRAPH DATA
      IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
         -1       0    0.62     0.0    0.62     0.0     0.0       0       1       0

                                  INPUT HYDROGRAPH
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.
    0.      0.      0.      0.      0.      0.      0.      0.      0.      0.

                   PEAK   6-HOUR  24-HOUR  72-HOUR   TOTAL VOLUME
            CFS      0.       0.       0.       0.             0.
            CMS      0.       0.       0.       0.             0.
         INCHES              0.0      0.0      0.0            0.0
             MM              0.0      0.0      0.0            0.0
          AC-FT               0.       0.       0.             0.
       THOUS CU M             0.       0.       0.             0.
```

SHEET 21 OF 26

```
                              HYDROGRAPH AT STA     1 FOR PLAN 1, RTIO 1
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
          0.          0.          0.          0.          0.          0.          0.          0.          0.          0.

                                 PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                         CFS       0.        0.        0.        0.             0.
                         CMS       0.        0.        0.        0.             0.
                      INCHES               0.0       0.0       0.0            0.0
                          MM               0.0       0.0       0.0            0.0
                       AC-FT                 0.        0.        0.             0.
                   THOUS CU M                0.        0.        0.             0.


      **********          **********          **********          **********          **********

                                         HYDROGRAPH ROUTING

                DEWATERING CORNWALL UPPER RES. DAM

                          ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                              2       1       0       0       0       0       1       0       0
                                                   ROUTING DATA
                   QLOSS   CLOSS     AVG    IRES   ISAME    IOPT    IPMP            LSTR
                     0.0     0.0     0.0       1       1       0       0               0

                          NSTPS   NSTDL     LAG   AMSKK       X     TSK   STORA  ISPRAT
                              1       0       0     0.0     0.0     0.0   -965.      -1

STAGE        939.60     940.10     940.40     941.00     942.00     944.00     945.00     946.00     948.00     950.00
             954.00     958.00     962.00     964.00     964.60

FLOW            0.0       1.40       3.10       3.60       5.20       7.50       8.40       9.10       9.70      10.20
              11.10      12.00      12.80      13.20      13.30

SURFACE AREA=      4.         8.        14.        23.        42.

    CAPACITY=      0.       104.       193.       474.      1107.

   ELEVATION=    940.       957.       965.       980.      1000.

                          CREL   SPWID   COQW    EXPW   ELEVL    COQL   CAREA    EXPL
                         934.0     0.0    0.0     0.0     0.0     0.0     0.0     0.0

                                                 DAM DATA
                                       TOPEL     COQD    EXPD  DAMWID
                                       966.6      3.1     1.5    325.

                                       STATION     2, PLAN 1, RATIO 1

                                     END-OF-PERIOD HYDROGRAPH ORDINATES
                          MO.DA  HR.MN  PERIOD  HOURS     INFLOW   OUTFLOW   STORAGE     STAGE

                           1.01   3.00      1    3.00         0.       13.      190.     964.4
```

Sheet 22 of 26

1.01	6.00	2	6.00	0.	13.	187.	964.1
1.01	9.00	3	9.00	0.	13.	183.	963.9
1.01	12.00	4	12.00	0.	13.	180.	963.6
1.01	15.00	5	15.00	0.	13.	177.	963.4
1.01	18.00	6	18.00	0.	13.	174.	963.1
1.01	21.00	7	21.00	0.	13.	170.	962.9
1.02	0.0	8	24.00	0.	13.	167.	962.6
1.02	3.00	9	27.00	0.	13.	164.	962.4
1.02	6.00	10	30.00	0.	13.	161.	962.1
1.02	9.00	11	33.00	0.	13.	158.	961.9
1.02	12.00	12	36.00	0.	13.	155.	961.6
1.02	15.00	13	39.00	0.	13.	151.	961.3
1.02	18.00	14	42.00	0.	13.	148.	961.1
1.02	21.00	15	45.00	0.	13.	145.	960.8
1.03	0.0	16	48.00	0.	12.	142.	960.5
1.03	3.00	17	51.00	0.	12.	139.	960.2
1.03	6.00	18	54.00	0.	12.	136.	959.9
1.03	9.00	19	57.00	0.	12.	133.	959.6
1.03	12.00	20	60.00	0.	12.	130.	959.3
1.03	15.00	21	63.00	0.	12.	127.	959.0
1.03	18.00	22	66.00	0.	12.	124.	958.7
1.03	21.00	23	69.00	0.	12.	121.	958.4
1.04	0.0	24	72.00	0.	12.	118.	958.1
1.04	3.00	25	75.00	0.	12.	115.	957.8
1.04	6.00	26	78.00	0.	12.	112.	957.5
1.04	9.00	27	81.00	0.	12.	109.	957.1
1.04	12.00	28	84.00	0.	12.	106.	956.8
1.04	15.00	29	87.00	0.	12.	103.	956.4
1.04	18.00	30	90.00	0.	12.	100.	956.1
1.04	21.00	31	93.00	0.	11.	97.	955.7
1.05	0.0	32	96.00	0.	11.	94.	955.4
1.05	3.00	33	99.00	0.	11.	92.	955.0
1.05	6.00	34	102.00	0.	11.	89.	954.7
1.05	9.00	35	105.00	0.	11.	86.	954.3
1.05	12.00	36	108.00	0.	11.	83.	954.0
1.05	15.00	37	111.00	0.	11.	81.	953.6
1.05	18.00	38	114.00	0.	11.	78.	953.2
1.05	21.00	39	117.00	0.	11.	75.	952.9
1.06	0.0	40	120.00	0.	11.	72.	952.5
1.06	3.00	41	123.00	0.	11.	70.	952.1
1.06	6.00	42	126.00	0.	11.	67.	951.8
1.06	9.00	43	129.00	0.	11.	65.	951.4
1.06	12.00	44	132.00	0.	10.	62.	951.0
1.06	15.00	45	135.00	0.	10.	59.	950.6
1.06	18.00	46	138.00	0.	10.	57.	950.3
1.06	21.00	47	141.00	0.	10.	54.	949.9
1.07	0.0	48	144.00	0.	10.	52.	949.5
1.07	3.00	49	147.00	0.	10.	49.	949.1
1.07	6.00	50	150.00	0.	10.	47.	948.7
1.07	9.00	51	153.00	0.	10.	44.	948.3
1.07	12.00	52	156.00	0.	10.	42.	947.9
1.07	15.00	53	159.00	0.	10.	40.	947.5
1.07	18.00	54	162.00	0.	9.	37.	947.1
1.07	21.00	55	165.00	0.	9.	35.	946.7
1.08	0.0	56	168.00	0.	9.	33.	946.3
1.08	3.00	57	171.00	0.	9.	30.	945.9
1.08	6.00	58	174.00	0.	9.	28.	945.5
1.08	9.00	59	177.00	0.	8.	26.	945.1
1.08	12.00	60	180.00	0.	8.	24.	944.7
1.08	15.00	61	183.00	0.	8.	22.	944.3
1.08	18.00	62	186.00	0.	7.	20.	944.0
1.08	21.00	63	189.00	0.	7.	18.	943.6
1.09	0.0	64	192.00	0.	7.	17.	943.2
1.09	3.00	65	195.00	0.	6.	15.	942.9
1.09	6.00	66	198.00	0.	6.	13.	942.6
1.09	9.00	67	201.00	0.	6.	12.	942.3

Sheet 3 of 22

1.09	12.00	68 204.00	0.	5.	11.	942.0
1.09	15.00	69 207.00	0.	5.	9.	941.8
1.09	18.00	70 210.00	0.	4.	8.	941.5
1.09	21.00	71 213.00	0.	4.	7.	941.3
1.10	0.0	72 216.00	0.	4.	6.	941.1
1.10	3.00	73 219.00	0.	3.	5.	940.9
1.10	6.00	74 222.00	0.	3.	5.	940.7
1.10	9.00	75 225.00	0.	3.	4.	940.5
1.10	12.00	76 228.00	0.	3.	3.	940.3
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1.11	3.00	81 243.00	0.	1.	1.	939.9
1.11	6.00	82 246.00	0.	1.	1.	939.9
1.11	9.00	83 249.00	0.	1.	1.	939.8
1.11	12.00	84 252.00	0.	1.	1.	939.8
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1.12	0.0	88 264.00	0.	0.	0.	939.7
1.12	3.00	89 267.00	0.	0.	0.	939.7
1.12	6.00	90 270.00	0.	0.	0.	939.7
1.12	9.00	91 273.00	0.	0.	0.	939.7
1.12	12.00	92 276.00	0.	0.	0.	939.6
1.12	15.00	93 279.00	0.	0.	0.	939.6
1.12	18.00	94 282.00	0.	0.	0.	939.6
1.12	21.00	95 285.00	0.	0.	0.	939.6
1.13	0.0	96 288.00	0.	0.	0.	939.6
1.13	3.00	97 291.00	0.	0.	0.	939.6
1.13	6.00	98 294.00	0.	0.	0.	939.6
1.13	9.00	99 297.00	0.	0.	0.	939.6
1.13	12.00	100 300.00	0.	0.	0.	939.6

PEAK OUTFLOW IS 13. AT TIME 0.0 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13.	13.	13.	13.	766.
CMS	0.	0.	0.	0.	22.
INCHES		0.20	0.78	2.28	9.19
MM		5.04	19.93	57.84	233.46
AC-FT		7.	26.	75.	190.
THOUS CU M		8.	32.	93.	234.

********** ********** ********** ********** **********

25 Ft. Depth / 11.5 days to dewater = 2.17 Ft/Day

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00
HYDROGRAPH AT	1	3.62	1	0.
		(1.61)		(0.0)
ROUTED TO	2	3.62	1	13.
		(1.61)		(0.38)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	964.60	964.60	966.00
STORAGE	193.	193.	222.
OUTFLOW	13.	13.	14.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	964.36	0.0	193.	13.	0.0	0.0	0.0

SHEET 26 OF 26

APPENDIX D

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REFERENCES

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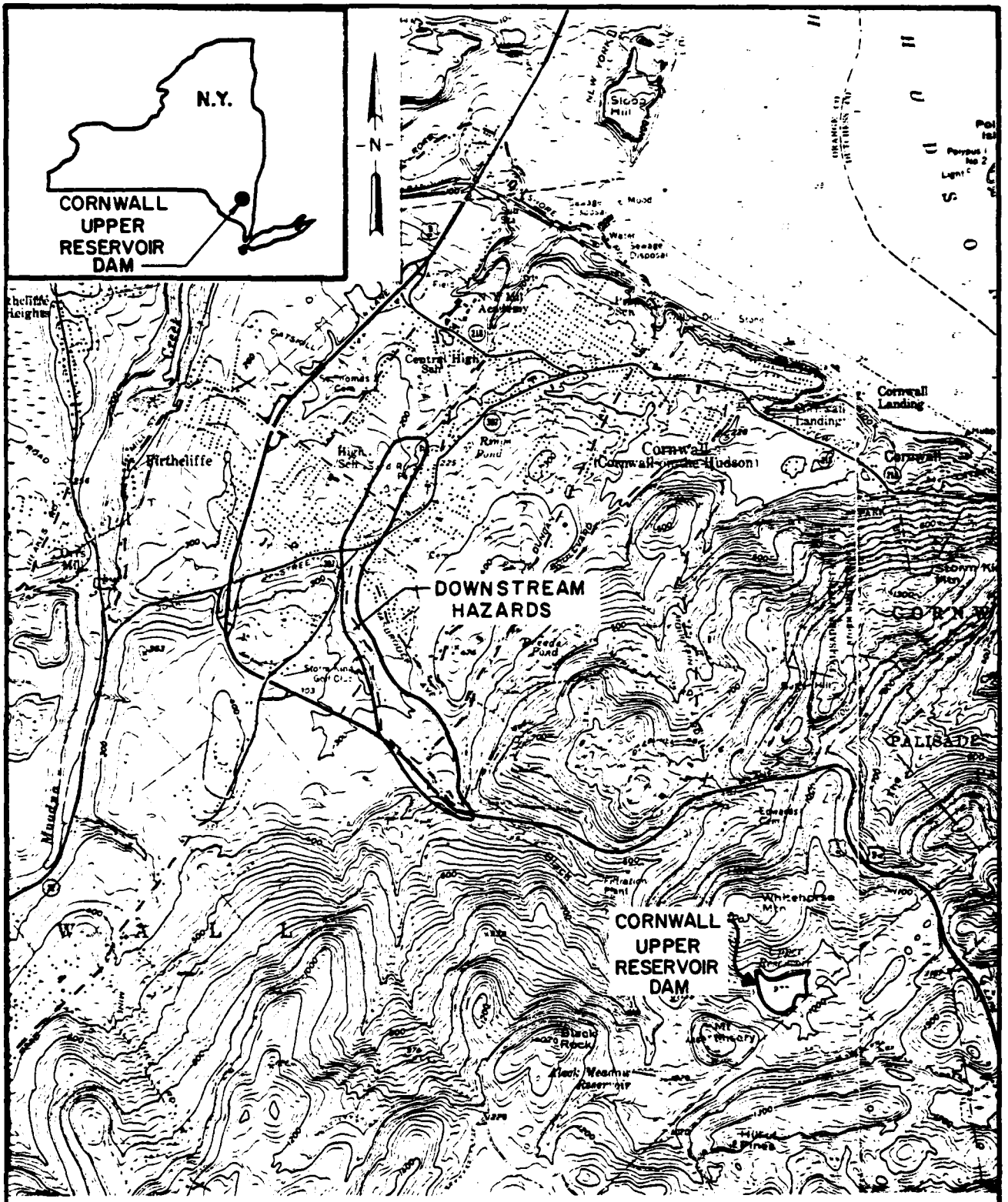
APPENDIX E

DRAWINGS

CONTENTS



SCALE 1:24000

1/2 0 1 MILE

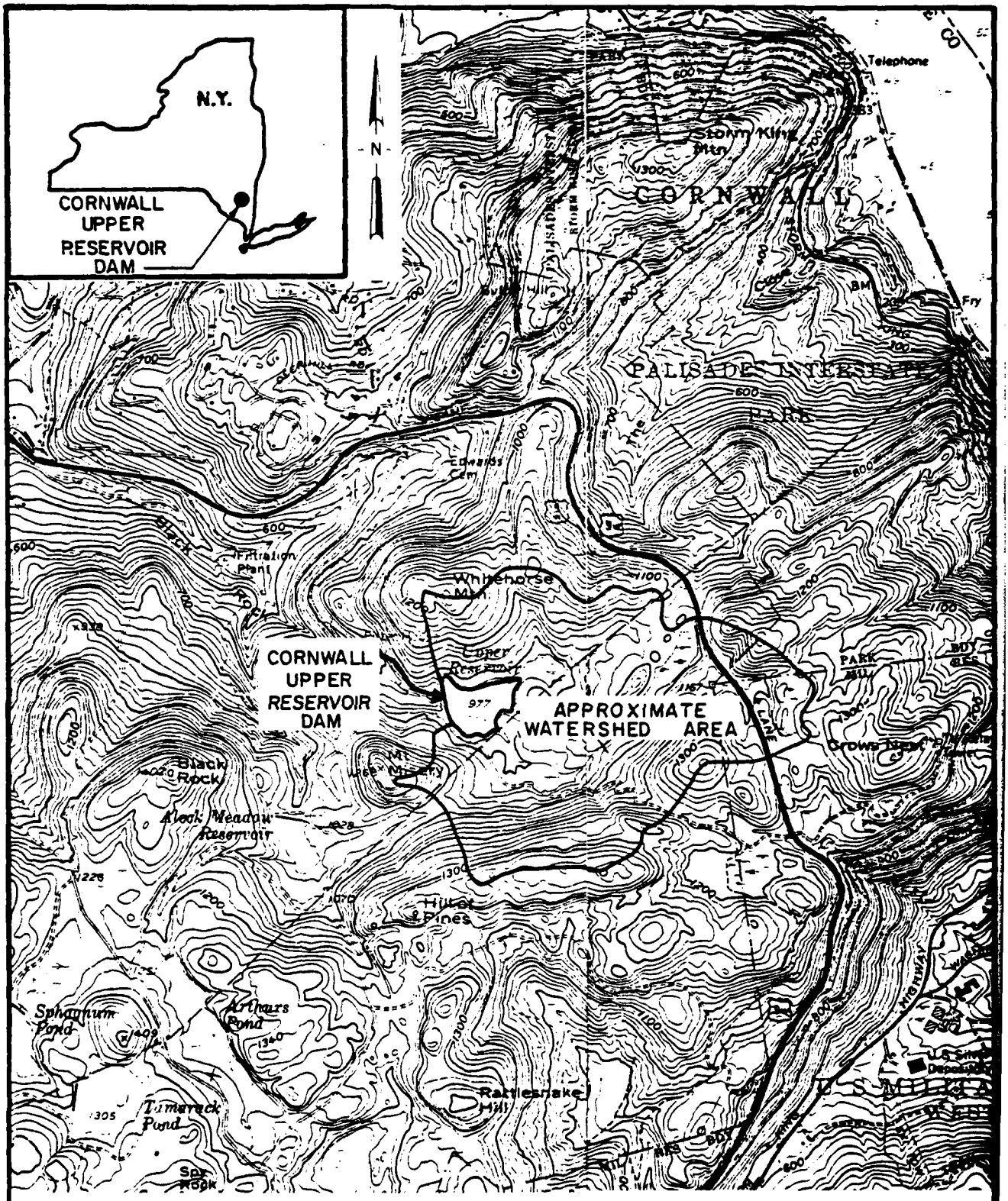
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0 1 KILOMETER

LOCATION PLAN

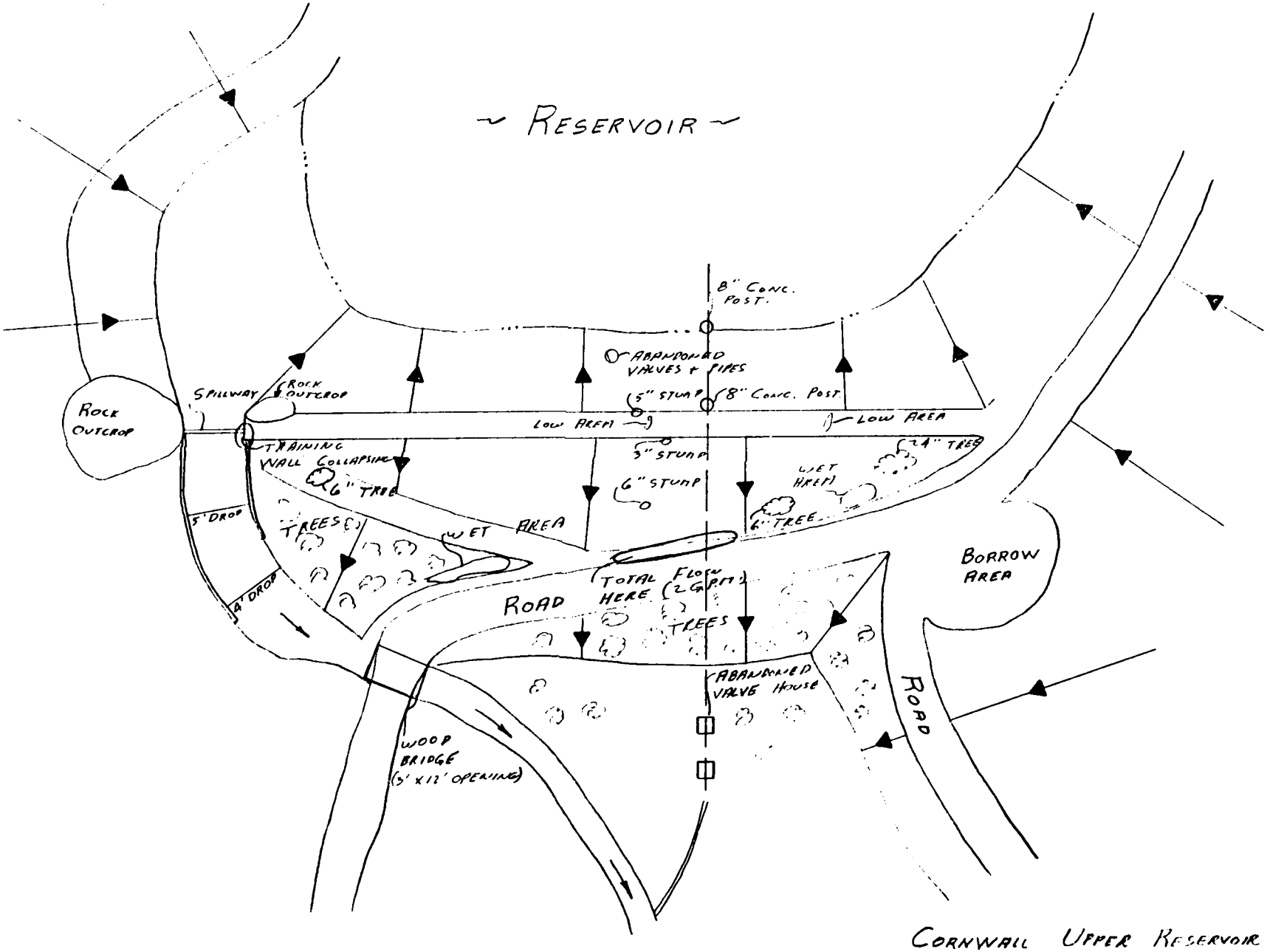
CORNWALL UPPER RESERVOIR DAM

REFERENCES:
1. U.S.G.S. 7.5' WEST POINT, N.Y. QUADRANGLE. 1957
2. U.S.G.S. 7.5' CORNWALL, N.Y. QUADRANGLE. 1957

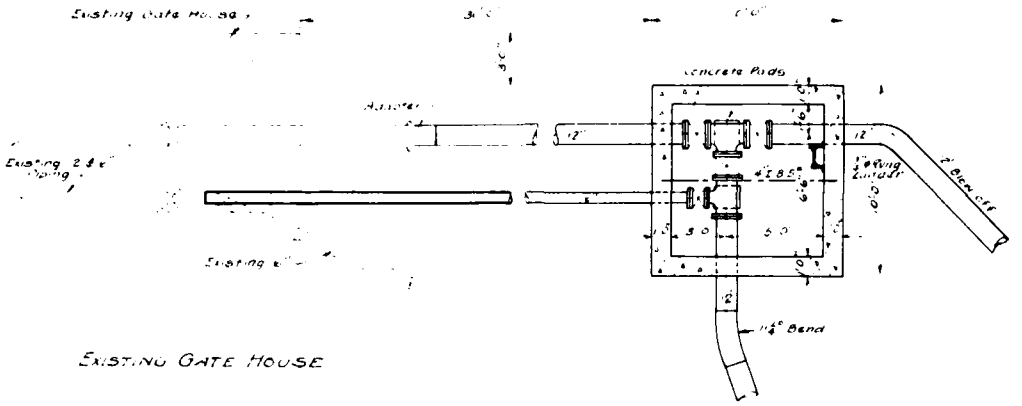


REFERENCES:
1. U.S.G.S. 7.5 WEST POINT, N.Y. QUADRANGLE. 1957
2. U.S.G.S. 7.5 CORNWALL, N.Y. QUADRANGLE. 1957

WATERSHED MAP
CORNWALL UPPER RESERVOIR DAM



CORNWALL UPPER RESERVOIR
FIELD SKETCH
PLATE 1

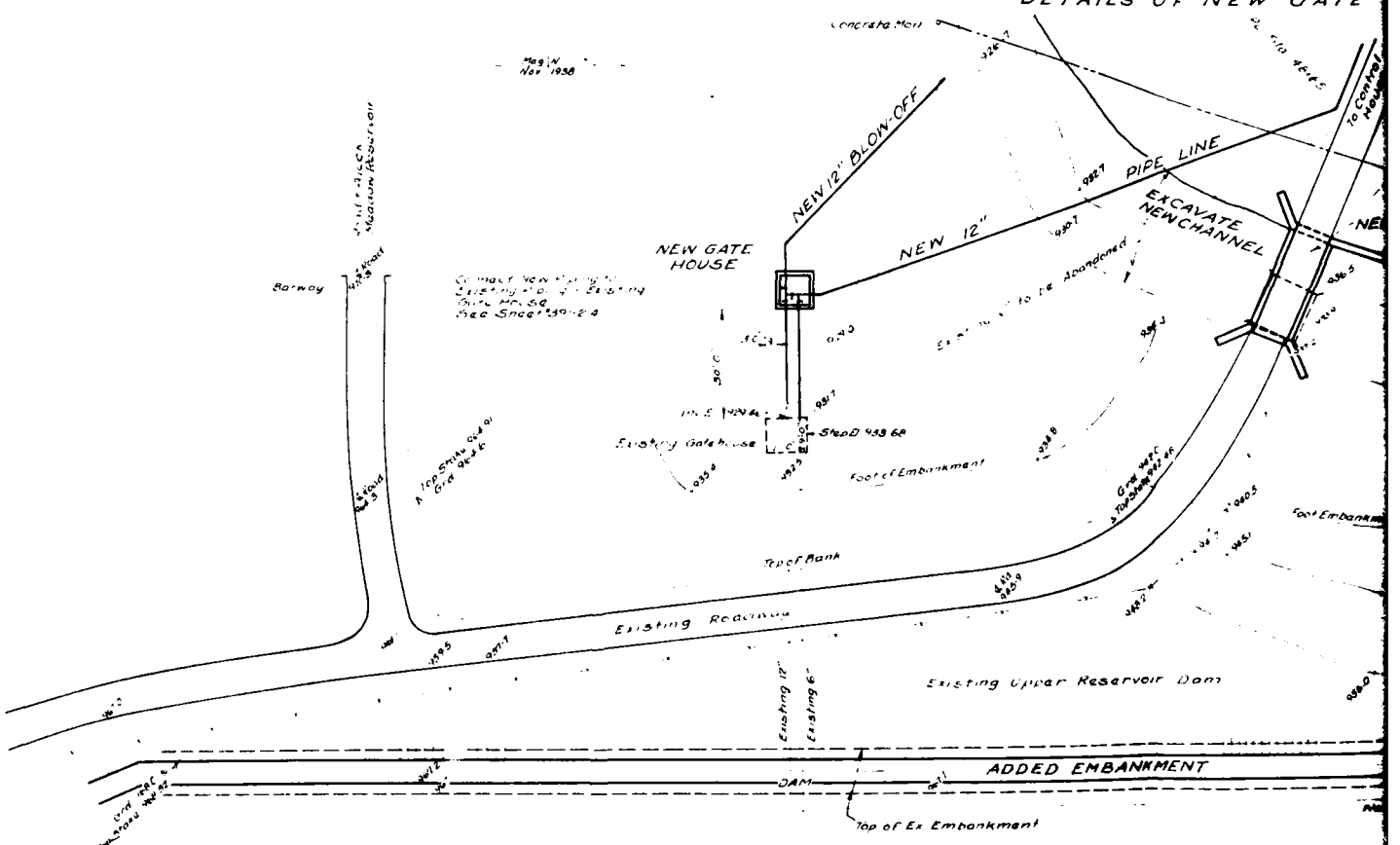


EXISTING GATE HOUSE

BASEMENT PLAN

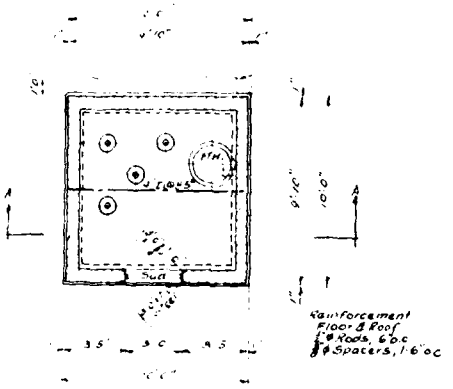
GROUND FLOOR PLA

DETAILS OF NEW GATE

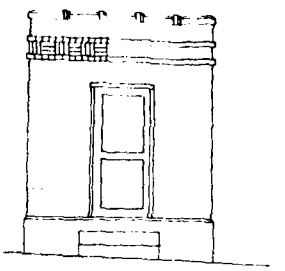


PLAN OF EXISTING UPPER RESERVOIR
SHOWING NEW SPILLWAY CONSTRUCTIO

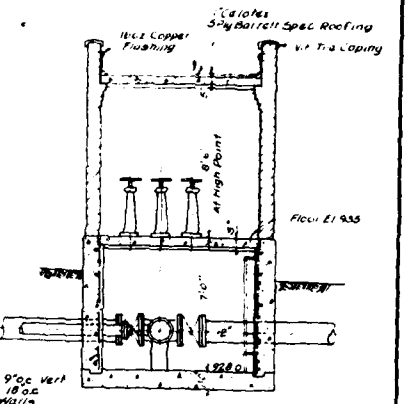
Note:- Wast Wall to Stop at Bottom of Roof Slab
Roof Slab to Project out 1'0 from outside
Face of Wall. Slope Roof from East to West



GROUND FLOOR PLAN

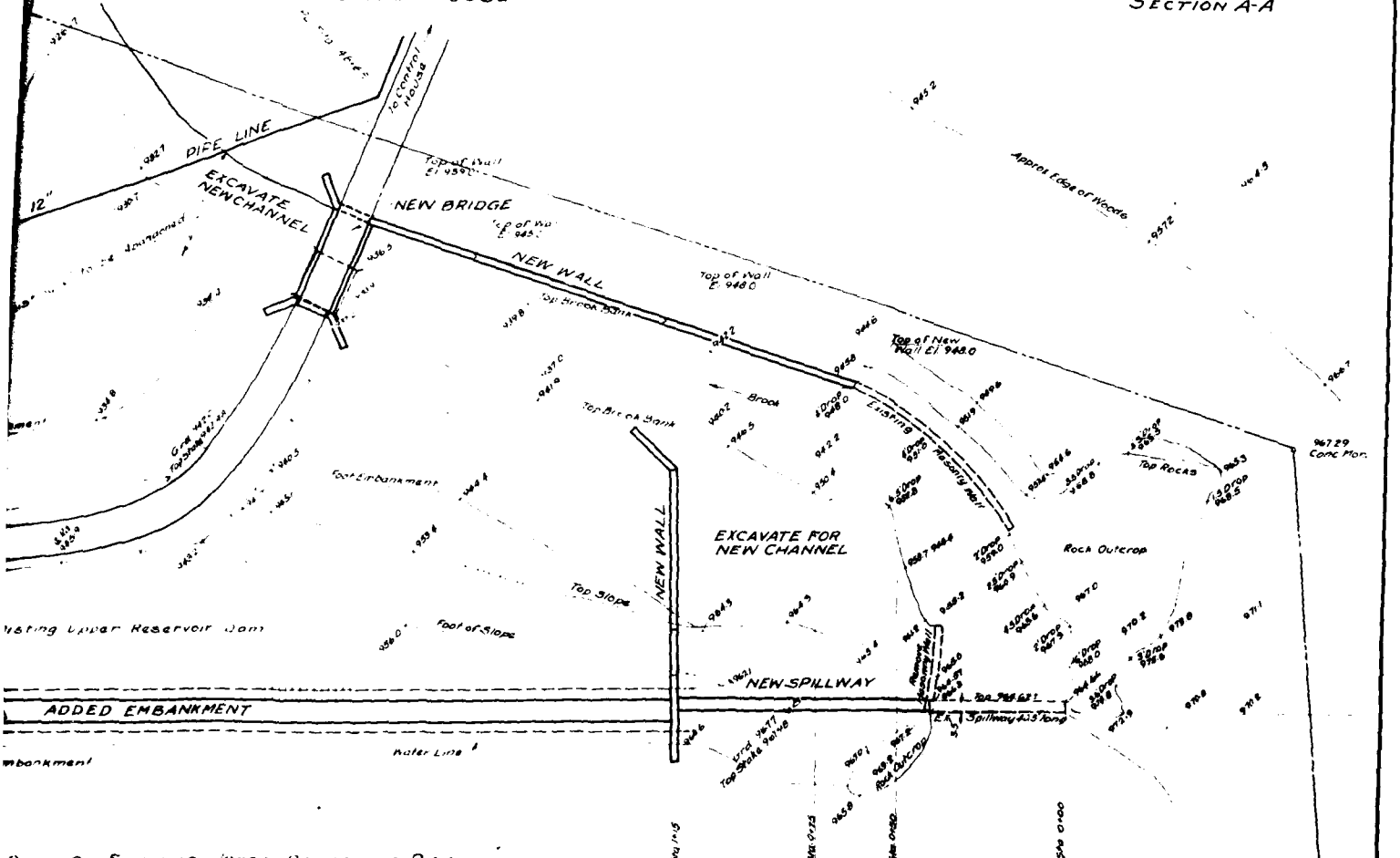


EAST ELEVATION



SECTION A-A

DETAILS OF NEW GATE HOUSE

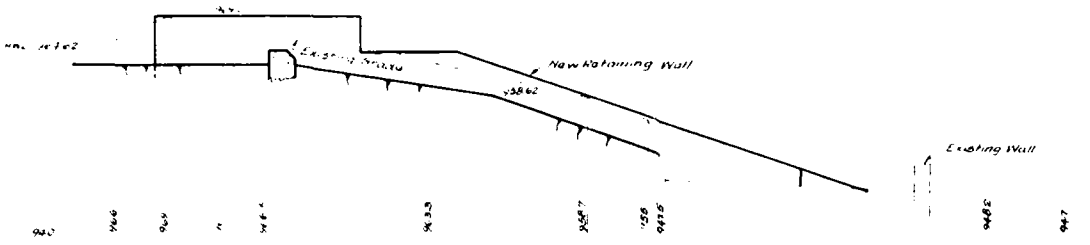


PLAN OF EXISTING UPPER RESERVOIR DAM
SHOWING NEW SPILLWAY CONSTRUCTION

CORNWALL, N.Y.
WATER WORKS IMPROVEMENT
CONTRACT NO. 2
UPPER RESERVOIR DAM

HENRY W. TAYLOR
CONSULTING ENGINEER
11 PARK PLACE, N.Y.C.

SCALE 1"=20'
DATE JAN 1899
SHEET NO. 39A-B45



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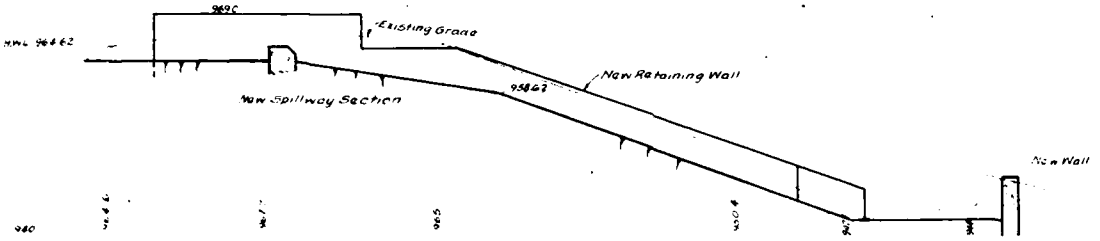

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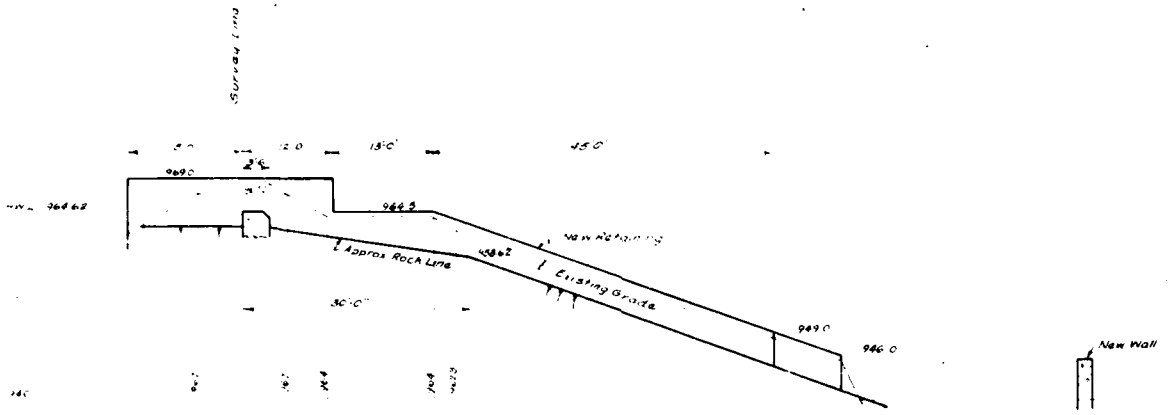

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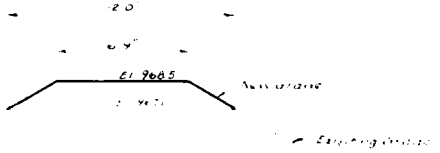
SECTIONS OF NEW SPILLWAY
Scale 1"=10'



TYPICAL SECTION OF
ADDED EMBANKMENT
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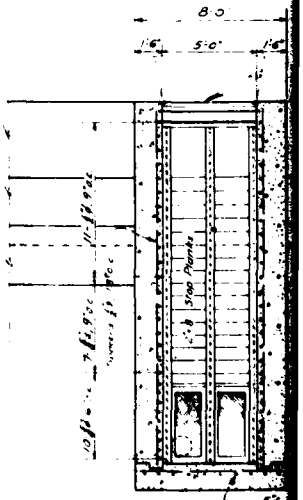

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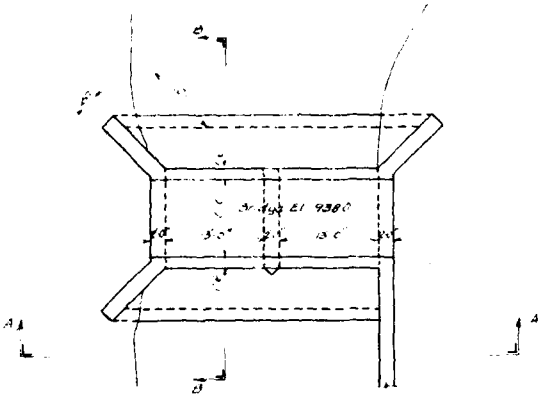
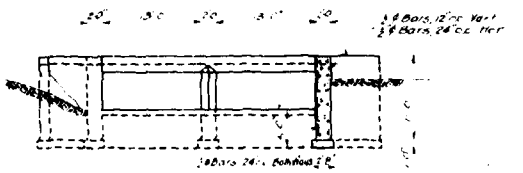


PLAN



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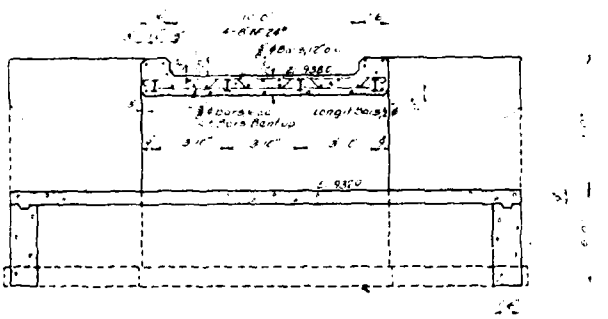

SECTION B B
NEW BRIDGE
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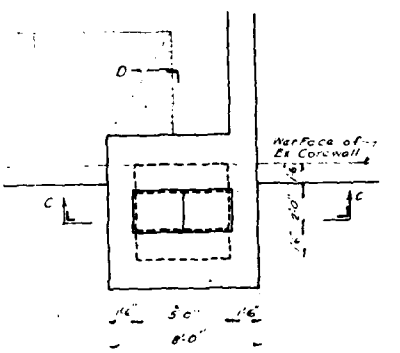

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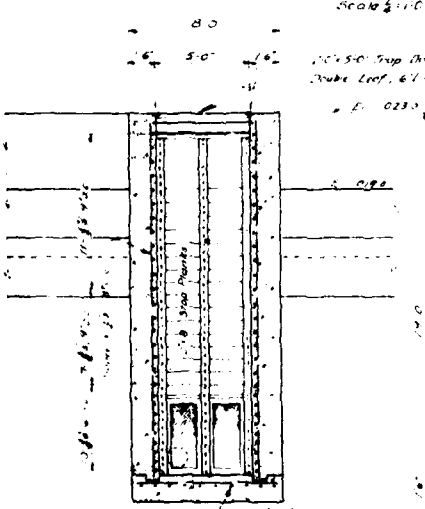

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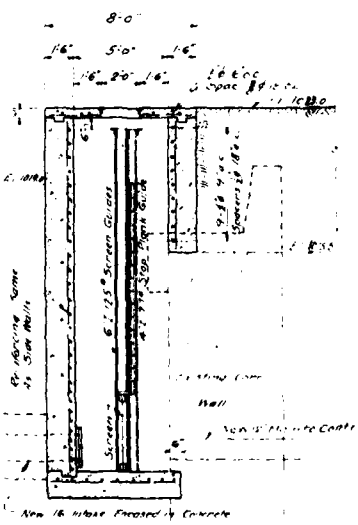
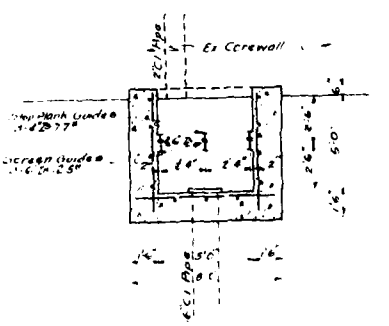


SECTION D-D

NEW INTAKE MANHOLE
See Sheet No. 1391-2-2.3/4



SECTIONAL PLAN

NEW INTAKE MANHOLE
Scale ½"=1'-0"

CORNWALL, N.Y.
WATER WORKS IMPROVEMENT
CONTRACT NO. 2
UPPER RESERVOIR DAM

HENRY W. TAYLOR
CONSULTING ENGINEER
11 PARK PLACE, N.Y.C.

SCALE 1/40
DATE: JAN. 1939
SHEET NO. 1391-2-2.1/2